A Coded Wire Tag Assessment of Birkenhead River Coho Salmon: 1982 Tag Application and 1984 Spawner Enumeration

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by

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ABSTRACT

Schubert, N.D., G.E. Rosberg, R.J. Cook and G.M.W. Cronkite. 1985. A coded wire tag assessment of Birkenhead River coho salmon: 1982 tag application and 1984 spawner enumeration. Can. MS Rep. Fish. Aquat. Sci. 1816: 55 p.

Coho juveniles in the Birkenhead River were captured and coded wire tagged during the fall of 1982. A total of 43,566 age 0+ and 3,432 age 1+ coho were released with codes 02 22 09 and 02 23 26 respectively. Mean size of tagged age 0+ coho was 55.8 mm and 2.0 g; tagged age 1+ coho averaged 84.7 mm and 7.0 g.

The subsequent spawner escapement was estimated at 11,524, of which an estimated 327 and 31 were tagged with codes 02 22 09 and 02 23 26 respectively. Estimated survival to escapement was 0.8% and 1.0% for the two respective tag codes.

Key words: Birkenhead River, coho salmon, coded wire tagging, escapement, survival.

RÉSUMÉ

Schubert, N.D., G.E. Rosberg, R.J. Cook and G.M.W. Cronkite. 1985. A coded wire tag assessment of Birkenhead River coho salmon: 1982 tag application and 1984 spawner enumeration. Can. MS Rep. Fish. Aquat. Sci. 1816: 55 p.

À l'automne 1982, on a capturé des saumons cohos juvéniles dans la rivière Birkenhead, auxquels on a posé des étiquettes métalliques codées. Au total, 43,566 cohos de 0^+ an et 3,432 poissons de 1^+ an portant respectivement les codes 02 22 09 et 02 23 26 ont été relâchés. La taille moyenne des cohos de 0^+ an étiquetés s'élevait à 55.8 mm et 2.0 g tandis que ceux de 1^+ an atteignaient en moyenne 84.7 mm et 7.0 g.

On a calculé que l'échappée ultérieure totalisait 11,524 poissons, dont environ 327 et 31 portaient respectivement les codes 02 22 09 et 02 23 26. La survie estimative jusqu'à l'échappée s'élevait respectivement à 0.8% et à 1.0% pour les deux séries de codes.

Mots-clés: rivière Birkenhead, saumon coho, étiquettes métalliques codées, échappée, survie.

INTRODUCTION

A coho salmon coded wire tagging (CWT) study was conducted during the autumn of 1982 in the Birkenhead River, a large tributary of the Harrison/ Lillooet River system located near Pemberton, B.C. (Fig. 1). This study was one of several recently initiated in the Fraser River system to determine, through the coast-wide mark recovery program, the exploitation rate, catch distribution and survival rate of specific coho stocks (Schubert 1982, 1984; Fedorenko and Cook 1982; Hutton **et al.** MS 1983; Schubert and Fedorenko 1985).

Birkenhead River coho were selected for study for two reasons. First, although the salmonid resource of the Birkenhead River system has been the subject of intensive investigation by both the International Pacific Salmon Fisheries Commission (IPSFC) and the Department of Fisheries and Oceans, comparatively little effort has been devoted to coho salmon. This study was designed, therefore, to document the life history characteristics, exploitation rate and harvest distribution of Birkenhead River coho salmon. Second, since Birkenhead River coho are a major Fraser River coho stock, with escapements during the 1970's averaging approximately 5% of the Fraser River system total, assessment of this stock received a high priority.

Birkenhead River coho juveniles were trapped and coded wire tagged during the autumn of 1982 and returning spawners were enumerated during the autumn and winter of 1984/5. This report describes the field techniques and documents the results of both the juvenile and adult components of the Birkenhead River CWT study. Detailed data presented here include juvenile catch by species, numbers of coho released with CWT's, size and age characteristics of coho juveniles and adults, estimates of total escapement and escapement by CWT code, and descriptions of rearing and spawning distributions. A full analysis of exploitation rate, survival rate and harvest distribution will be published when catch data are finalized.

STUDY AREA DESCRIPTION

The Birkenhead River arises in the Coast Mountains near Sun God Mountain (2,280 m) and flows in a southerly direction for approximately 54 km before entering the upper end of Lillooet Lake, 1 km north of the upper Lillooet River confluence (Fig. 1). The river drains a mountainous, partially glaciated watershed of 596 km^2 and is among the largest tributaries of the Harrison/Lillooet system.

The Birkenhead River flows for much of it's length through a narrow valley bounded by steep mountains. Tributary streams enter from steep side valleys and generally flow directly into the main river. As a result, salmonid habitat is largely confined to mainstem and side channel areas, to short seepage-fed flood plain tributaries and to the deltaic portions of larger tributaries. The river is passable to adult chinook salmon as far upstream as Taillefer Creek (34 km) (Koster MS 1976); however, a 2 m rock falls in a deep bedrock canyon located 27.5 km upstream from Lillooet Lake delineates the apparent upper limit of coho migration. Below the canyon, the river flows for 19.5 km through a narrow, flat bottomed valley and is characterized by long rapids and riffles, frequent deep pools and isolated braided areas. The river flows from the mountain valley onto the Lillooet River flood plain approximately 8 km upstream, then flows to the mouth in a slow moving, meandering channel parallel to the upper Lillooet River.

The Birkenhead River hydrograph reflects a dominant spring snow melt modified by fall and spring precipita-

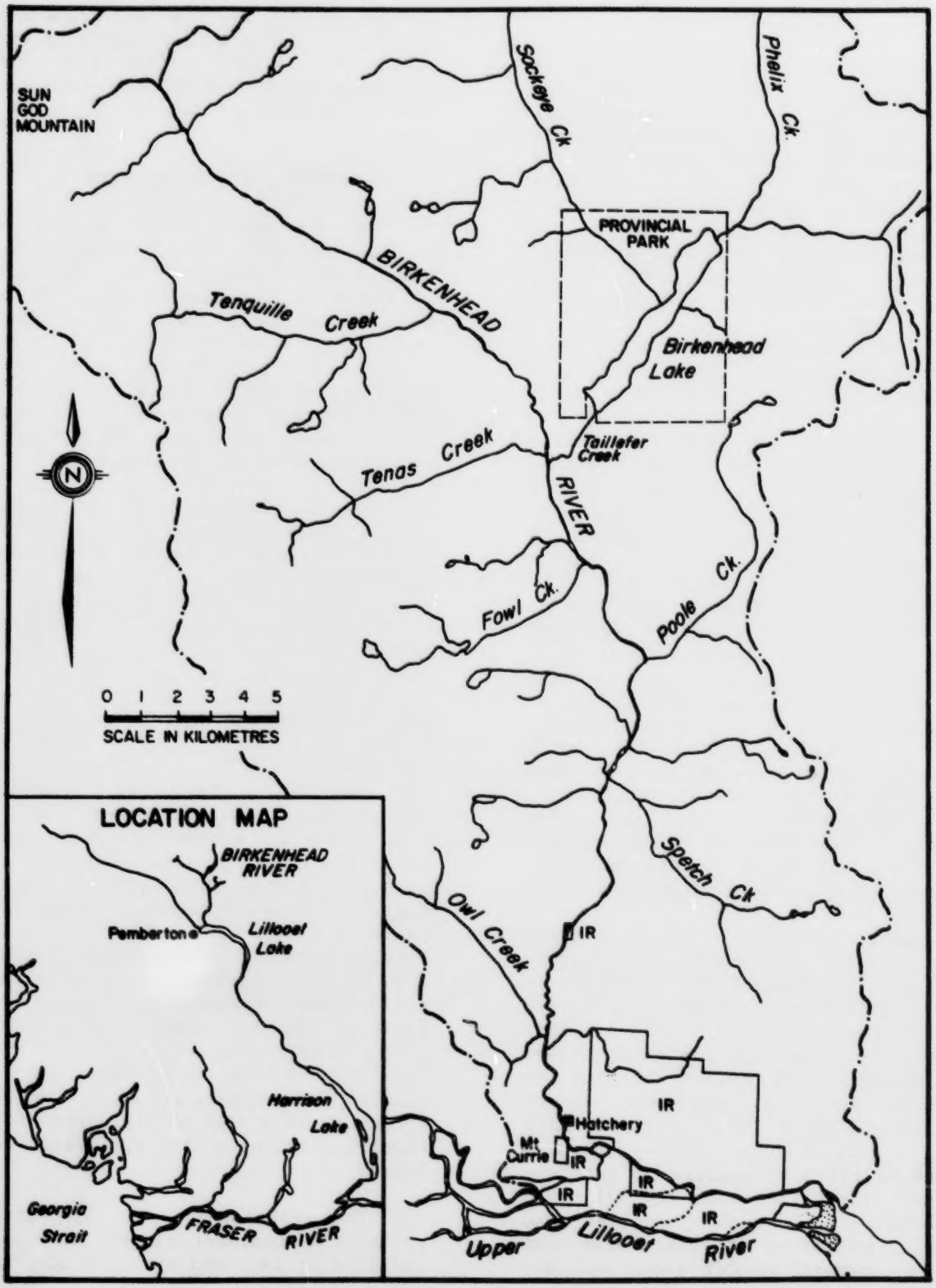

Figure 1 Map of Birkenhead River system and watershed

tion inputs (Fig. 2, Appendix 1). Daily discharges averaged 23.9 cubic meters per second (m^3/s) over a 26 year period of record ending in 1981. Maximum and minimum mean daily discharges generally occurred in June (70.7 m^3/s) and March (7.5 m^3/s) respectively.

Human settlement in the Birkenhead watershed is concentrated in the lower reaches where Indian reserves of the Mount Currie Band border the river (pop. 1,161; IANDC 1983). Agricultural activities have had the greatest impact on the Birkenhead River salmonid resource. In 1947, the lower river was diverted to the current channel from one which drained directly into the upper Lillooet River, approximately 4.5 km above Lillooet Lake. In 1949, the outlet of Lillooet Lake was dredged, lowering the lake level by 2 m and draining a large marsh on the upper Lillooet River delta. Since that time, sections of the Birkenhead River and much of the lower 40 km of the upper Lillooet River have been dyked. Other human influences have been associated with the use of the valley as a transportation (railroad, highway) and hydroelectric transmission corridor. Rights-of-way are sprayed with herbicides and, as recently as 1972, train derailments have deposited deleterious materials into the river.

The Birkenhead River supports populations of sockeye, coho and chinook salmon (Appendix 2) as well as cutthroat trout, Dolly Varden char and whitefish. Sockeye are dominant, with an average escapement (1951-1984) of 69,000 and a maximum of 173,500 recorded in 1974. Coho escapements averaged 3,300 since 1951, with a maximum of 15,750 recorded in 1952. Chinook escapements averaged 700 since 1951, with a maximum of 3,500 recorded in 1957.

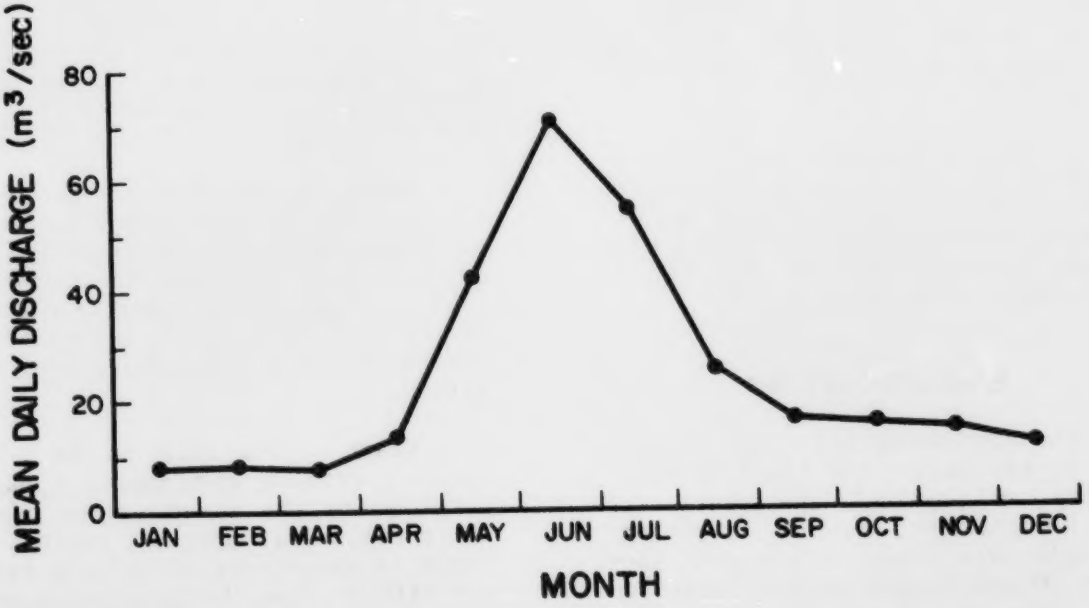

Figure 2 Mean daily discharge by month in the Birkenhead River near Mt. Currie, 1946-1971

The Birkenhead River system has been the subject of intensive fisheries activities since early in the century. The Department of Fisheries operated a salmon hatchery on the Birkenhead River near Owl Creek from 1905 until the hatchery program was abandoned in 1936. The facility, with a capacity of approximately 45 million eggs, was primarily for sockeye although up to 1.5 million coho, 150,000 chinook and 197,000 Kamloops trout eggs were taken in some years. The primary purpose of this facility was to augment natural salmon production in order to offset the effects of over fishing. The facility was also used to distribute Kamloops trout from Lloyd's Creek (Kamloops) to local lakes and streams and, during the period 1919 to 1931, the facility played a major role in attempts to reestablish sockeye production in systems impacted by the Hell's Gate slide. Birkenhead River sockeye were transplanted to the Eagle, Quesnel, Nechako and Stuart systems, and to the Skeena system to compensate for Skeena sockeye transplanted to the upper Fraser River system (Aro 1979). The only recorded sockeye transplant into the Birkenhead River was from Sweltzer River in 1929.

A salmon hatchery was reestablished on the Birkenhead River in 1977 in an attempt to reverse apparent declines in the chinook escapement. The current capacity of this facility is approximately 200,000 eggs.

REACH DESCRIPTIONS

The Birkenhead River was divided into 10 reaches on the basis of homogeneity of physical characteristics such as gradient, channel morphology and substrate type. Extensive sections of homogeneous habitat were divided into several reaches in order to more closely relate biological data to the sample sites. The reaches are described below and detailed in Fig. 3. Unless otherwise noted, river distances are in kilometers upstream from Lillooet Lake. Local names for landmarks or creeks without official names are bracketed.

Reach 1 (mouth to km 7.4). Reach 1 is characterized by a meandering channel with a low gradient, a sand and mud substrate and extensive stream side vegetation. The Mount Currie Indian reserve borders both sides of the channel for virtually the entire reach.

Reach 2 (km 7.4 to km 9.7). Reach 2 is a transition area where the river flows from the mountain valley onto the Lillooet River flood plain. The reach, which extends from the road crossing immediately below the Birkenhead Hatchery downstream to the confluence of an unnamed tributary (Warbonnet Creek), is characterized by long riffles, isolated deep pools and a gravel substrate.

Warbonnet Creek meanders for 4 km across the flood plain, entering the Birkenhead River at km 7.4. The creek is characterized by a mud substrate, rooted aquatic vegetation and thick riparian growth.

Reach 3 (km 9.7 to km 14.7). Reach 3 extends upstream to a series of rapids located 0.5 km below the Mount Currie - Birken road crossing (Twin Bridges). The reach is characterized by a 2% gradient, a rapids/pool stream form and a boulder/gravel substrate.

Reach 4 (km 14.7 to km 17.5). Reach 4 extends upstream to a narrow gorge where the river passes over a series of small, passable falls. The reach is characterized by long rapids and riffles, deep isolated pools and a substrate of mixed gravel/cobble, with boulders present in the faster sections. Pools in this reach provided extensive adult coho holding habitat.

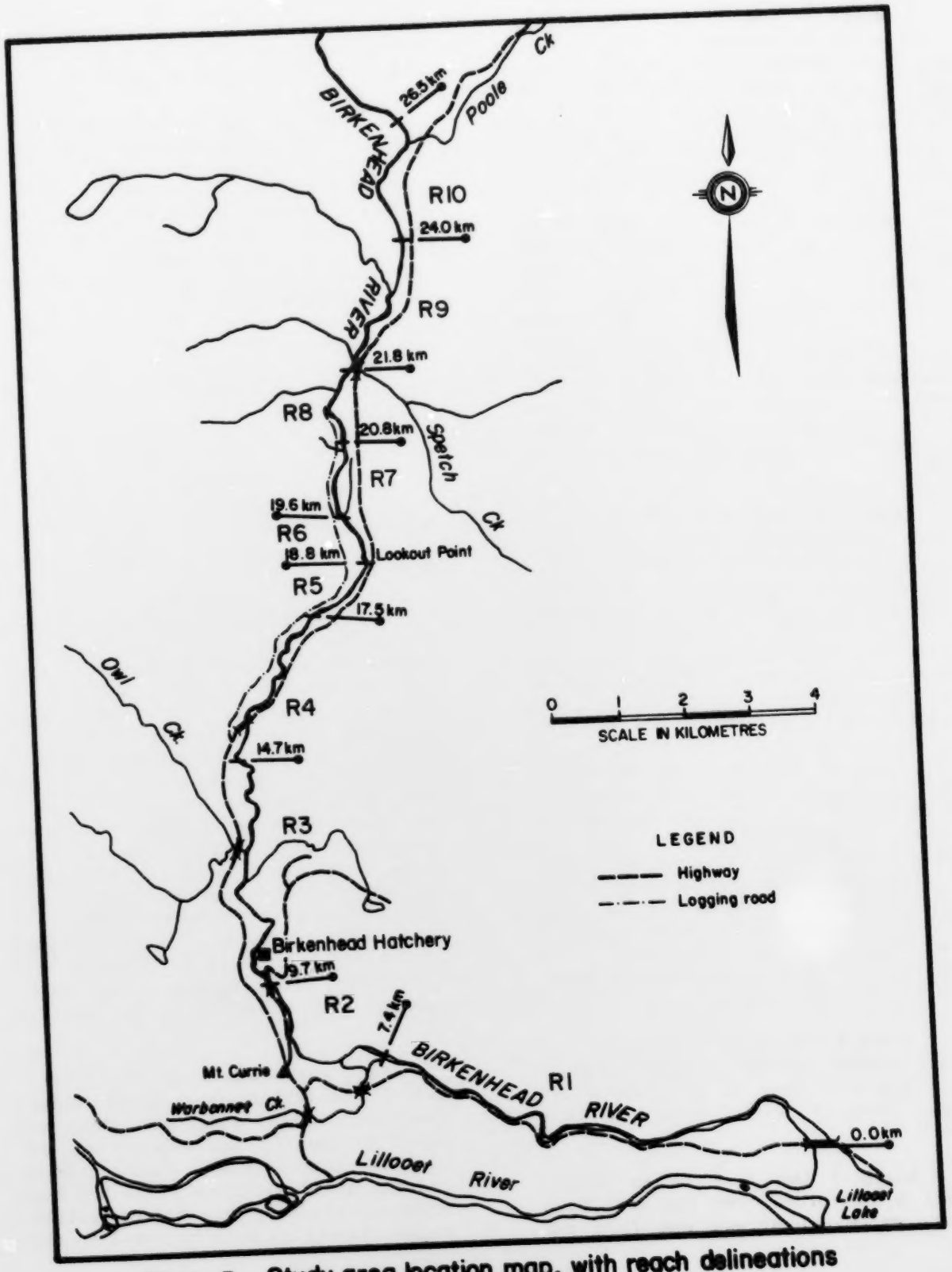

Figure 3 Study area location map, with reach delineations

Reach 5 (km 17.5 to km 18.8). This reach is similar in character to Reach 4, except extensive gravel deposits occur where the channel broadens and a small slough, characterized by a mud substrate, extensive instream debris and overhanging vegetation, joins the mainstem from the west.

Reaches 6 to 9 (km 18.8 to km 24.0). In these reaches (Hindu Flats), a broad valley bottom and a gradient of less than 1% result in a river morphology characterized by long riffles, frequent deep pools, extensive braiding and instream debris, frequent undercut banks and a predominantly gravel substrate. Small tributaries and side channels are common; the most important are described below.

Reach 6 (km 18.8 to km 19.6). Three small seepage channels and a small tributary enter Reach 6 from the west and east respectively. The channels are less than 250 m in length and 3 m in width and have gravel deposits near the confluences. The tributary, which enters the river near km 19, is impassable beyond the railway crossing 300 m upstream.

Reach 7 (km 19.6 to km 20.8). Two tributaries enter the Birkenhead River in Reach 7. Cool Creek, an 850 m long stream which enters from the east near km 19.6, is characterized by a silt substrate and cooler water temperatures than the main river. The second tributary, which enters from the west, is shorter and has a silt substrate with isolated gravel deposits in the upper areas.

Reach 8 (km 20.8 to km 21.8). A small unnamed tributary enters Reach 8 from the west near km 21. Important side channels also occur in this reach.

Reach 9 (km 21.8 to km 24.0). Reach 9 is joined from the west by a small ephemeral stream and from the east by Spetch Creek, a stream with limited salmonid habitat which enters the Birkenhead River at km 21.8.

Reach 10 (km 24.0 to km 26.5). Reach 10 extends upstream to the outlet of the Birkenhead canyon. In this reach, a narrow valley and a higher gradient result in a river morphology characterized by a single channel, a rapids/pool stream form and a rubble substrate. Poole Creek, the only major tributary in Reach 10, is an 11 km long stream which enters the Birkenhead River at km 25.7. In the lower 1.5 km, Poole Creek has a low gradient, a gravel substrate and extensive instream debris.

METHODS

JUVENILE PROGRAM

Fish Capture

Minnow traps baited with frozen chum salmon roe were the only capture technique used in this study. Trapping was conducted from September 15 to November 18, 1982. Up to 80 traps were set daily in areas of slow to moderate current and adequate cover, such as in log jams, among rooted aquatic plants and submerged debris, and under overhanging banks. Captured fish were removed from the traps at least once and often twice each day, sorted to species and enumerated. All coho juveniles were transported in 23 litre plastic buckets to nearby pens (described below) where they were held for coded wire tagging. All other species were released at the capture site.

Each reach was intensively trapped in isolation from other areas. Traps were baited after each check and moved frequently in response to declining catch levels. When all known rearing areas within a reach had been trapped, trapping was halted and the tagged juveniles were returned to that

area.

Juvenile Coho Holding

Prior to tagging, all coho juveniles were held in instream pens constructed from 0.9 m x 1.8 m plastic (ABS) pipe frames and 4.8 mm mesh marquisette netting. Snap-on plastic covers provided shade and protection from avian predators. Floats (boat-bumpers) were attached to the ABS frame uprights to permit the pens to float during high discharges. Holding sites in each discrete trapping area were selected on the basis of four criteria: protection from turbulence; proximity to trapping areas; the presence of an adequate supply of clean, oxygenated water at low flows; and ease of access. When holding areas were unavailable at the capture site, juveniles were transported to the nearest available holding area.

Daily catches were graded by size into separate pens in order to minimize cannibalism. Pen loading densities were loosely based on those recommended by McNeil and Bailey (1975), but were modified on the basis of local conditions and fish behaviour. Mortalities were enumerated and removed daily.

Coded Wire Tagging

Age Class Separation: Preliminary surveys conducted during August 1982 indicated that approximately 6% of the juvenile coho population in the Birkenhead River was age 1+. In view of possible brood year specific genetic and behavioural differences which could bias subsequent analyses, all coho juveniles captured during the study were sorted by age class in order to tag each brood year with a unique tag code. Eye diameter was selected as the primary sorting criterion on the basis of data reported by Robinson (MS 1976) which indicated that eye size could be useful for rapid sorting by age class in the field. The present study used a fixed point cutoff of 5.5 mm on the basis of preliminary survey data. Eye diameter was measured using a plastic template with circular holes calibrated in 0.5 mm increments.

Tagging Procedure: The CWT equipment and machine maintenance procedures used during the study were similar to those described by Armstrong and Argue (1977). Tagging occurred between September 20 and November 19, 1982. On each tagging day, tag implant location was checked for each tag lot by bisecting the skull of a tagged coho with a scalpel along the median plane. If the tag was not in the preferred position in the cartilaginous wedge of the skull (the chondrocranium), implant depth was adjusted and the procedure repeated until tag placement was correct. Following this check, the remaining fish were tagged.

During the tagging operation, the fish were anaesthetized using a stock Tricaine Methane Sulphonate (TMS) solution of 7.5 g per litre of water which was further diluted, as conditions dictated, in a 7.5 litre plastic basin. The two age groups were assigned separate nose molds, implant depths and tag codes. The fish were then marked by adipose fin removal, tagged, and passed through a quality control device to ensure the CWT was present. All coho juveniles with a nose-fork length greater than 45 mm were tagged, with the exception of any diseased or injured fish which were noted and excluded from tagging.

When possible, a random sample of up to 350 coho was removed from the recovery bucket throughout each tagging operation and retained for a minimum of 24-hours. These fish were examined for adipose clip quality, anomalies and CWT retention. Any coho without a CWT or with a poor clip was retagged or reclipped and the tag lot totals adjusted to reflect the numbers

released with complete adipose clips and CWT's. All other tagged fish were either immediately transported to the original trapping area and released or held until the cessation of trapping, then transported and released.

Tag Codes: Two CWT codes were used during the 1982 Birkenhead River study: age 0+ and age 1+ coho were tagged with codes 02 22 09 and 02 23 26 respectively.

Biological Sampling

In each reach, at least 25 juveniles from the age 0+ and 1+ tag groups were randomly sampled prior to release to determine the reliability of age discrimination and the average size at release. A scale smear was taken with a scalpel from the "preferred region", as defined by Clutter and Whitesel (1956), nose-fork length was measured to the nearest mm, mean wet weight (± 0.1 gram) was determined by weighing the sample in aggregate on an Ohaus triple beam balance, and eye diameter, as defined as the greatest distance between the margins of the scleral cartilage, was measured to the nearest 0.5 mm as described above.

In each reach, an additional 100 coho juveniles were sampled as above prior to tagging. These samples were more representative of the stream population than the tag lot samples since coho less than 45 mm were included; however, biases due to trap selectivity were not addressed.

Physical Sampling

Surface water temperatures were recorded daily at all trapping sites using pocket thermometers. As well, records from a continuously recording thermograph installed by the IPSFC in Reach 4 (km 15.5) were obtained for the period August 18, 1982 to January 10, 1983.

ADULT PROGRAM

Aerial Survey

The Birkenhead River was surveyed by helicopter on October 30 and November 26, 1984 in order to document the holding locations of adult coho and to provide visual estimates of spawner abundance. On each survey, the river was flown from the mouth to the limit of coho passage, approximately 27.5 km upstream. Observers wore sunglasses with polarizing filters to reduce surface glare. Sighting conditions and observations of live and dead coho were recorded on a reach specific basis.

Fish Capture

Beach Seining: The use of a 5 cm mesh beach seine (6.1 m x 30.4 m) to capture adults for disk tagging was attempted early in the program. The net was set by hand in holding pools using long end ropes; however, the technique proved ineffective and was discontinued.

Angling: Adult coho were captured by angling in the Birkenhead River during the period November 6 to November 22, 1984. Angling efforts were concentrated in several deep pools in Reach 4 where adult coho held prior to migrating past a small falls to the spawning grounds. A continuous upstream movement of fish permitted the pools to be angled on a daily basis. The fish were captured using a double barbless hook baited with small pieces of fluorescent orange wool. Captured fish were beached with the aid of a landing net, transferred to a tagging tray, disk tagged and released.

Tagging Procedure

Adult coho were disk tagged in a wooden tray (10 cm x 10 cm x 100 cm) constructed with a flexible plastic bottom and a meter stick recessed in

one side. Only adult coho were tagged; precocious males (nose-fork length less than 33 cm) were not tagged due to an expected low recovery rate.

All coho were tagged using the Petersen disk tagging system, consisting of two 2.2 cm diameter laminated cellulose acetate disks and one 0.7 cm diameter transparent plastic buffer disk threaded through centrally punched holes onto a 7.7 cm long nickel pin. The pin was inserted with pliers through the musculature and pterygiophore bones approximately 1.2 cm below the anterior portion of the dorsal fin insertion. The disk tags were arranged with one on each side of the back and with a buffer disk on the pin head side. The tags were secured by twisting the tag pin into a double knot. Green disk tags were used to reduce color contrast and thereby minimize recovery and predation biases. One disk tag per pair was numbered with a unique code for individual identification.

Each disk tagged fish received a secondary mark to allow the assessment of disk tag loss. A 0.7 cm diameter hole was punched through the operculum of each disk tagged fish using a single hole paper punch. Care was taken to ensure gill tissues were not damaged.

The following information was recorded for each fish released with a disk tag: date and location (reach) of tagging, disk tag number, nose-fork length (± 0.5 cm), sex, and presence or absence of the adipose fin. The condition of the fish at release was recorded as 1 (swims away vigorously), 2 (swims away sluggishly) or 3 (requires ventilation). Any bleeding from the gills or abdomen was also noted.

Census Procedure

Stream Surveys: The Birkenhead River was surveyed on foot on a weekly basis during the period November 28, 1984 to January 6, 1985. On each survey, a three-person crew equipped with sunglasses with polarizing filters covered all known spawning areas, with equal survey effort in each area when possible. In each reach, live adults were enumerated visually and all carcasses were sampled (described below), cut in two with a machete to avoid counting the same fish on subsequent surveys, and returned to the stream. A long handled gaff was used to retrieve carcasses from pools and an axe was used to free carcasses from river ice.

A partial weir was installed in Reach 5 in an attempt to intercept carcasses carried downstream by the current. The weir, which spanned approximately one-half the channel, was constructed from 7.6 cm mesh plastic coated fencing supported by steel T-bar driven into the substrate at two meter intervals along a wind felled tree.

Biological Sampling: All coho carcasses recovered during the 1984 study were sampled, and all sample data were recorded on a reach-specific basis. Each carcass was first examined for a secondary mark and then for a disk tag to reduce the bias from examining disk tagged fish more closely for secondary marks than untagged fish. If a disk tag was present, the number was recorded and the tag removed from the carcass. All carcasses were measured for postorbital-hypural plate length (± 0.5 cm) and five scales were removed from each preferred region for subsequent age determination. Sex was confirmed by incising the abdomen of each carcass. Spawning success was recorded for females as a percentage based on an average fecundity of 2,500 (Wood et al. MS 1979), and as spawned or unspawned for males.

All carcasses were also examined for adipose clips. The adipose condition was recorded (unclipped, or: 1 -

complete clip, flush with dorsal surface; 2 - partial clip, nub present; 3 - questionable, appears clipped but fungus or decomposition obscured area) and for all adipose clipped individuals, the head was removed posterior to the eye orbit, placed in a plastic bag coded for the above sample data and frozen.

In order to estimate CWT retention, it was necessary to evaluate the level of CWT loss which occurred after death as a result of decomposition or scavenging. Carcass condition was recorded as fresh (gills red or mottled), moderately fresh (gills white, body firm), moderately rotten (body intact but flesh soft), or extremely rotten (skin and bones). The absence of eye(s) was also recorded because poorly placed CWT's can migrate to the eye musculature where they are vulnerable to loss by scavengers.

CWT Recovery

Coded wire tag removal was conducted under the supervision of Salmon Services Branch personnel. The heads were first thawed, then rinsed to remove sand and gravel. After dissection and repeated passes through a metal detector the CWT was located, separated from tissue and decoded under a binary microscope.

When a CWT was not initially detected, the head was passed through a strong magnetic field and the process was repeated. If a CWT was not detected, a more sensitive metal detector was used. If a CWT was still not detected, the head was X-rayed to confirm a CWT was not present.

Escapement Estimation

The escapement of adult coho salmon to the Birkenhead River was calculated from the disk tagging data using the adjusted Petersen formula (Chapman modification) (Ricker 1975):

$$N = \frac{(M + 1)(C + 1)}{(R + 1)}$$

where N = population estimate
M = number of disk tags applied
C = number of carcasses examined for disk tags
R = number of disk tags or secondary marks recovered

Confidence limits ($p < 0.05$) were calculated for the population estimate by substituting the following into the above equation:

$$R + 1.92 \pm 1.960 \sqrt{R + 1.0}$$

The above method was used to generate population estimates for the total 1984 return of adult coho. Individual estimates for the return of adipose clipped adult coho and for males and females were calculated by applying the ratio of the individual estimates to the total population estimate.

RESULTS

JUVENILE PROGRAM

Fish Capture

Coho Salmon: A total of 55,531 juvenile coho salmon were captured by expending an estimated 33,495 trap-hours (1,395.6 trap-days) effort over a 64-day trapping period (Table 1). This catch included approximately 3,400 coho juveniles which were lost from vandalized pens in Reach 2. Approximately 6,600 were subsequently captured in that area and released with CWT's.

The largest catches occurred in Reach 7, which contributed 55% of the total catch and accounted for 55% of the total trapping effort. The smallest catches occurred in reaches 9 and 5, which contributed 1% and 4% respectively to the total catch and together

Table 1. Catch of coho juveniles by reach in the Birkenhead River system, 1982

Location	Trapping period	Trap-hours	Trap-days	Coho catch	CPUE	
					Trap-hr.	Trap-day
Reach 2[a]	Nov. 9 - 17	5,209.8	217.1	10,042	1.93	46.3
Reach 5	Oct. 25 - 28	2,818.3	117.4	2,460	0.87	21.0
Reach 6	Nov. 1 - 4	3,605.5	150.2	5,901	1.64	39.3
Reach 7	Sep. 20 - Oct. 21	18,327.8	763.7	30,702	1.68	40.2
Reach 8	Sep. 15 - 17	3,106.0	129.4	5,746	1.85	44.4
Reach 9	Sep. 15 - 16	427.5	17.8	680	1.59	38.2
TOTAL	Sep. 15 - Nov. 17	33,494.9	1,395.6	55,531	1.66	39.8

[a] Includes 3,421 coho (1,746.6 trap-hours or 83 trap-days effort) lost when the holding pen was vandalized.

Table 2. Catch of species other than coho by reach in the Birkenhead River system, 1982[a]

Location	Rainbow trout	Cutthroat trout	Dolly Varden	Whitefish[b]	Sculpins	Lamprey
Reach 2	-	-	-	-	64	2
Reach 5	4	9	1	-	-	1
Reach 6	12	4	2	1	-	-
Reach 7	16	14	15	1	-	1
Reach 8	4	-	5	-	-	1
Reach 9	14	-	30	-	-	1
TOTAL	50	27	53	2	64	6

[a] For capture dates, see Table 1.
[b] All identified as mountain whitefish (**Prosopium williamsoni**).

Table 3. Summary of coho coded wire tagging results by age class in the Birkenhead River system, 1982 (data from Appendix 3).

Age	Number processed	Estimated post-tagging mortality	Adipose only and tag loss	Poor adipose clip	Number released with clips and CWT's	Tag code
0+	44,875	187	168	954	43,566	02 22 09
1+	3,553	13	6	102	3,432	02 23 26

accounted for 10% of the total trapping effort. Coho catch per trap-hour and trap-day averaged 1.66 and 39.8 respectively during the 1982 program.

Nonsalmon Species: A total of 64 sculpins (**Cottus sp.**), 53 Dolly Varden char (**Salvelinus malma**), 50 rainbow trout (**Salmo gairdneri**), 27 cutthroat trout (**Salmo clarki clarki**), 6 lamprey and 2 mountain whitefish (**Prosopium williamsoni**) were captured during 1982 (Table 2). Sculpins were confined to the lower reaches; other species were captured in most areas.

Coded Wire Tagging

A total of 44,875 age 0+ and 3,553 age 1+ coho juveniles were adipose clipped and coded wire tagged during 1982 (Table 3, Appendices 3a and 3b). When adjustments were made for short term (24-hour) tag loss, mortality and incomplete adipose clips, the number released with tags and identifiable adipose clips was 43,566 age 0+ and 3,432 age 1+ coho. Due to operational problems, approximately 25% of the tagged fish were not subsampled for adipose clip quality and tag retention; average values were applied to those tag groups and release values were adjusted accordingly.

Short term tag loss for age 0+ coho averaged 0.4%, with a daily tag lot range of 0% to 1.1%; delayed tag loss for age 1+ coho averaged 0.2%, with a daily tag lot range of 0% to 0.5%. Post-tagging mortality was generally low (187 age 0+ and 13 age 1+) with the exception of unusually high mortalities in the October 18 and 21 tag groups which resulted from poor pen placement during high flows.

The incidence of poor adipose fin clips for age 0+ coho averaged 2.3%, with a daily tag lot range of 0% to 8%; the incidence of poor fin clips for age 1+ coho averaged 3.1%, with a daily tag lot range of 0.4% to 9.3%. The high incidence of poor clips was attributed to staff inexperience.

The incidence of disease, damage and structural anomalies among age 0+ and age 1+ coho subsamples held for at least 24-hours was 1.7% and 18.4% respectively (Appendices 4a and 4b). Among age 0+ coho, anomalies were infrequent; among age 1+ coho, the most prevalent conditions were nose damage (14.9%) and scale loss (1.9%), both of which were associated with abrasion against the sides of the pens during the protracted holding period. The incidence of naturally missing adipose fins was 0.06% and 0% among age 0+ and 1+ coho respectively and is unlikely to effect subsequent assessment.

Delayed Tag Loss: Delayed CWT

Table 4. Estimated age composition by reach of coho juveniles released with coded wire tags in the Birkenhead River system, 1982 (n = sample size).

Location	Release group size	Sample data and adjusted age composition				
		n	Age 0+		Age 1+	
			%	Number	%	Number
Code 02 22 09 (Age 0+)						
* Reach 2	6,301	4	100	6,301	0	-
Reach 5	2,610	48	100	2,610	0	-
* Reach 6	5,375	6	100	5,375	0	-
Reach 7	17,760	137	100	17,760	0	-
Reach 8	11,520	86	100	11,520	0	-
TOTAL	43,566	281	100	43,566	0	-
Code 02 23 26 (Age 1+)						
* Reach 2	400	1	42.2	169	57.8	231
Reach 5	257	41	36.6	94	63.4	163
* Reach 6	499	2	42.2	211	57.8	288
Reach 7	1,410	87	60.9	859	39.1	551
Reach 8	866	66	13.6	118	86.4	748
TOTAL	3,432	197	42.2	1,451	57.8	1,981

* Weighted mean age composition used due to inadequate sample size.

loss was assessed in tagged individuals which had migrated from the original area of release to recapture sites in other areas. A total of 670 age 0+ and 26 age 1+ coho juveniles were recaptured between 7 and 60 days after release (Appendix 3c). The incidence of tag loss in age 0+ and age 1+ juveniles was 1.0% and 7.7% respectively, an increase from the short term tag loss level of 0.4% and 0.2% respectively.

Tag Group Sampling

Age Composition: Scale-age verifications from each CWT release group (Appendix 5) were weighted by release group size to estimate the true age composition of the coho juveniles released with CWT's (Table 4). The CWT releases consisted 95.8% of age 0+ and 4.2% of age 1+ coho juveniles. This proportion was identical to that observed in the more representative catch samples (Appendix 6); however, only 92.7% of the juveniles released with CWT's were tagged with the age 0+ code. The larger age 0+ juveniles tended to be misidentified as age 1+ juveniles, resulting in an estimated 1,451 age 0+ juveniles released with the age 1+ tag code (code 02 23 26) (Table 4). The age 0+ code (code 02 22 09) consisted entirely of age 0+ juveniles. As a result, an estimated 96.8% and 100% of the age 0+ and age 1+ juveniles respectively were re-

Table 5. Mean size of coho juveniles released with coded wire tags in the Birkenhead River system, 1982 (n = sample size).

Location	n	Mean length (mm) (± 95% CL)		n	Mean weight (g)
		Age 0+ (02 22 09)			
Reach 2	50	63.0	(± 2.0)	50	2.87
Reach 5	50	56.4	(± 2.2)	50	2.07
Reach 6	50	59.8	(± 2.6)	50	2.11
Reach 7	150	53.7	(± 1.3)	150	1.80
Reach 8	100	52.9	(± 1.6)	100	1.73
Mean[a]	-	55.8		-	1.99
		Age 1+ (02 23 26)			
Reach 2	50	83.8	(± 2.0)	50	7.43
Reach 5	50	84.3	(± 2.3)	50	6.92
Reach 6	50	84.7	(± 1.9)	50	6.64
Reach 7	150	85.0	(± 1.4)	150	7.10
Reach 8	100	84.7	(± 1.7)	75	6.94
Mean[a]	-	84.7		-	7.02

[a] Weighted by CWT release group size.

leased with the correct code.

Length and Weight: The mean length and weight of coho juveniles released with CWT's is reported in Appendix 5 and summarized in Table 5. The age 0+ (code 02 22 09) and age 1+ (code 02 23 26) release groups averaged 55.8 mm and 1.99 g, and 84.7 mm and 7.02 g respectively. Little reach-specific variability was noted in the size of age 1+ juveniles released with CWT's; however, age 0+ juveniles from the upper reaches were smaller while age 0+ juveniles from Warbonnet Creek, a small Reach 2 tributary, were significantly ($p < 0.05$) larger than those released in other areas.

Water Temperature

Mean daily water temperatures in the Birkenhead River are detailed in Appendix 7 and Fig. 4. Temperatures declined from 12.8° C in August to 1.9° C in December. Maximum daily temperatures during the period of tagging ranged from 16° C to 3° C and were not a factor in juvenile mortality during the study.

ADULT PROGRAM

Run Timing

The 1984 Birkenhead River coho run arrived in the river in October

and, on the basis of observations during disk tagging operations, most of the run had entered the river by mid-November. Coho adults held in mainstem pools for several weeks prior to moving onto the spawning grounds. Major holding areas were located in reaches 3, 4 and 5, with smaller holding pools located throughout the upper reaches (Appendix 8).

Spawning was first observed in late November; peak spawning and die-off occurred in mid and late December respectively. Spawning continued through the end of the study and, based on the number of adults holding at that time, presumably continued into February.

The migratory timing of Birkenhead River coho through the lower Fraser River was estimated from CWT recoveries in the gill net test fishery at Albion. Birkenhead River coho were recovered by the test fishery on October 23 (2 recoveries), November 13 (1) and November 15 (1), and a coho marked with a spaghetti tag in the Harrison River on October 15 was recovered on the spawning grounds on December 19. These data indicate that Birkenhead River coho passed through the lower Fraser River between mid October and mid November.

Spawner Distribution

In 1984, Birkenhead River coho were observed spawning in the mainstem, side channels and tributaries of reaches 3 through 10 (Appendix 8). Spawners were not observed in reaches 1 or 2, although coho were observed holding in Reach 2 during the November 26 aerial survey. The majority of coho spawned in reaches 5, 6 and 8, with 42% (431 fish) of the carcasses recovered in Reach 8 (Table 6). Observed distributions are described in

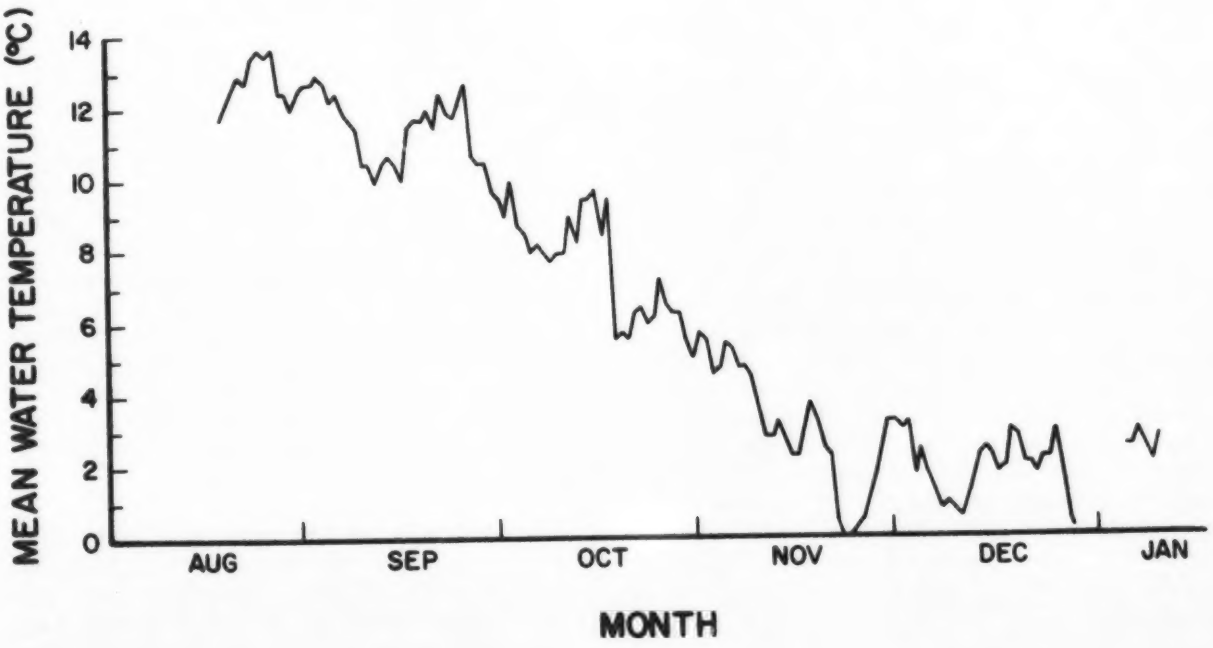

Figure 4 Mean daily water temperature in the Birkenhead River, August 18, 1982 to January 10, 1983

Table 6. Distribution of adult coho carcasses recovered in the Birkenhead River system, 1984 (data from Appendix 8).

Recoveries	Reach										Total
	1	2	3	4	5	6	7	8	9	10	
Total	0	1	12	40	165	272	101	431	0	7	1,029
Rel. %	0	0.1	1.2	3.9	16.0	26.4	9.8	41.9	0	0.7	-
Disk Tags	0	0	0	3	21	29	14	52	0	2	121
Adipose Clips	0	0	1	3	6	16	10	43	0	0	79

detail below.

In reaches 3 and 4, scattered spawning was observed in isolated gravel deposits associated with large boulders. These reaches were used primarily as holding areas, especially a series of pools near a small falls in Reach 4 where coho held prior to moving to the major spawning areas upstream. In Reach 5, spawning was confined to broad, shallow sections of the mainstem. In reaches 6 through 8, similar areas near debris jams also supported spawners; however, spawning was most frequently observed in short, groundwater fed tributaries and mainstem side channels. The most important spawning areas in the system were a number of small, shallow, slow moving tributaries which join the mainstem from the west in reaches 6 and 7, and a long groundwater fed side channel located approximately 20 km upstream on the west side of Reach 8. Very few spawners were observed in Reach 9, and none were observed in the mainstem areas of Reach 10; however, approximately 100 spawners were observed in the lower 1 km of Poole Creek, the only major tributary of Reach 10.

Estimation of Spawner Population

Disk Tag Application: A total of 1,379 adult coho salmon were released with disk tags and a further 11 precocious males were released untagged during the period November 6 to November 22, 1984 (Appendix 9). The condition of disk tagged fish at release was generally good, with the exception of 15 coho which were bleeding from hooking injuries to the abdomen. When subsequent spawning ground recoveries were compared, the proportion of this group recovered (0%) was significantly less ($p < 0.01$, difference in proportions test, Dixon and Massey 1969) than that of coho released in good condition (8.9%). Since the differential recovery level showed no apparent relationship to body size or sex, it was concluded that the coho released in poor or fair condition were subject to tagging related mortality. These fish were eliminated from the disk tag group, reducing the final disk tag application total to 1,364 (Table 7).

The sex of all coho released with disk tags was recorded during tagging operations; however, the accuracy of sex identification at this stage was limited because, in many cases, the development of sexually dimorphic traits was not advanced and internal examinations could not be made. To

Table 7. Summary of disk tag application and adult recovery results by sex and adipose clip status.

Group	Disk tags applied	Carcasses examined	Recoveries			Recovery rate (%)
			Secondary mark only	Disk tag	Total	
Males	818*	511	3	69	72	8.7
Females	546*	518	1	48	49	9.2
Adipose Present	1,295	950	2	106	108	8.3
Adipose Absent	69	79	2	11	13	18.8
Total	1,364	1,029	4	117	121	8.9

* Adjusted for incorrect identification.

test the accuracy of sex identification at tagging, recorded sex at application and recovery were compared for the 117 disk tagged coho recovered on the spawning grounds (Appendix 10). An estimated 6.3% of the females and 5.8% of the males were misidentified during disk tag application. When these estimates were applied to the disk tag release data, an estimated 818 (60.0%) males and 546 (40.0%) females were released with disk tags.

Carcass Recovery: A total of 1,030 coho salmon carcasses were recovered during foot surveys conducted between November 20, 1984 and January 6, 1985 (Table 7, Appendix 8). Of that total, 511 (49.6%) were adult male, 518 (50.3%) were adult female and 1 (0.1%) was a precocious male, 121 (11.7%) had disk tags or secondary marks and 79 (7.7%) had adipose clips.

The incidence of carcasses marked with disk tags or secondary marks ranged from 5.0% to 14.0% between time periods (Table 8) and from 0% to 28.6% between reaches (Table 9); however, a difference in proportions test showed no significant difference ($p < 0.05$) between recovery periods or reaches, except the mark incidence in reaches 2 and 3 was significantly less than that in other reaches. Since very little spawning occured in reaches 2 or 3 (Appendix 8), this bias should have little effect on study results.

The incidence of carcasses marked with adipose clips ranged from 4.4% to 10.0% between time periods (Table 8) and from 0% to 10.0% between reaches (Table 9); however, as noted with disk tag recoveries, no significant difference ($p < 0.05$) in adipose clip incidence was noted between recovery period or between reaches, except the incidence in Reach 5 was significantly less than in Reach 8.

Disk Tag Loss: Of the 121 carcasses recovered with disk tags or secondary marks, 117 had both disk tags and secondary marks, 4 had secondary marks only and none had disk tags only (Table 7, Appendix 8). The disk tag and secondary mark loss rates were 3.3% and 0% respectively.

Elapsed Time to Recovery: Elapsed time between disk tag application

Table 8. Summary of disk tag and adipose clip incidence by recovery period.

Recovery period	Total recoveries	Disk/secondary mark		Adipose mark	
		Number	%	Number	%
Nov. 20 to Nov. 30	20	1	5.0	2	10.0
Dec. 04 to Dec. 06	45	4	8.9	2	4.4
Dec. 11 to Dec. 14	150	21	14.0	9	6.0
Dec. 18 to Dec. 21	221	29	13.1	15	6.8
Dec. 28 to Dec. 30	306	34	11.1	23	7.5
Jan. 03 to Jan. 06	287	32	11.1	28	9.8
Total	1,029	121	11.8	79	7.7

Table 9. Summary of disk tag and adipose clip incidence by recovery location.

Recovery location (reach)	Total recoveries	Disk/secondary mark		Adipose mark	
		Number	%	Number	%
2	1	0	0.0	0	0.0
3	12	0	0.0	1	8.3
4	40	3	7.5	3	7.5
5	165	21	12.7	6	3.6
6	272	29	10.7	16	5.9
7	101	14	13.9	10	9.9
8	431	52	12.1	43	10.0
9	0	0	0.0	0	0.0
10	7	2	28.6	0	0.0
Total	1,029	121	11.8	79	7.7

Table 10. Summary of disk tag application and recovery by fish size.

Nose-fork length (cm)	Disk tags applied			Disk tags recovered			Recovery rate (%)
	Male	Female	Total	Male	Female	Total	
31 - 40	13	1	14	0	0	0	0.0
41 - 50	180	21	201	6	1	7	3.5
51 - 60	271	149	420	19	8	27	6.4
61 - 70	274	327	601	32	31	63	10.5
71 - 80	86	34	120	13	9	22	18.3
81 - 90	8	0	8	2	0	2	25.0
Total	832	532	1364	72	49	121	8.9

and recovery averaged 40.5 days and ranged from 17 to 59 days (Appendix 10). The mean elapsed time for males was slightly greater than for females, averaging 42.5 and 37.7 days respectively.

Recovery Selectivity by Length and Sex: Size related biases in the disk tag application and carcass recovery samples were examined using a Kolmogorov-Smirnov two-sample test (Sokal and Rohlf 1981). Bias in the application sample was assessed by comparing the continuous length frequency distributions of the disk tagged and untagged spawning ground recoveries. No differences were noted ($D = 0.11$; $D_{0.05} = 0.13$) indicating that the samples were drawn from the same distribution and that the application sample was unbiased with respect to size.

Recovery bias was assessed by partitioning the application sample into recovered and nonrecovered components and comparing the respective continuous length frequency distributions. The distributions were significantly different ($D = 0.22$; $D_{0.05} = 0.13$) indicating the recovery sample was biased with respect to size. This bias was more obvious when disk tag application and recovery data were stratified in 10 cm increments of nose-fork length and recovery rates calculated for the pooled data (Table 10). Recovery rates increased with size class, ranging from 0% in the 31-40 cm class to 25.0% in the 81-90 cm class. With the exception of the 81-90 cm class, the difference in recovery rates between classes was statistically significant ($p < 0.05$; difference in proportion test).

Sex related biases were examined by partitioning the application and recovery samples as above and comparing the sex compositions within each (Table 11). The sex ratios of recovered and nonrecovered disk tagged coho were not significantly different ($p < 0.05$; difference in proportion test), indicating the recovery sample was unbiased with respect to sex; however, the proportion of males was significantly ($p < 0.05$) higher in disk tagged versus untagged spawning ground recoveries, indicating the application sample was biased toward males.

Population Estimates: The 1984 escapement of Birkenhead River coho adults, calculated from data reported

Table 11. Sex composition of disk tag application and spawning ground recovery samples.

	Disk application sample			Spawning ground sample		
	Recovered on spawning ground	Not recovered	Total	Disk or secondary mark present	Disk or secondary mark absent	Total
% Male	59.5	60.0	60.0	59.5	48.4	49.7
% Female	40.5	40.0	40.0	40.5	51.6	50.3
Sample Size	121	1,243	1,364	121	908	1,029

in Table 7, was 11,524 (Table 12). The upper and lower confidence limits were 13,743 and 9,656 respectively. The population estimates for males and females of 5,795 and 5,729 respectively were calculated by applying the ratio of the individual mark-recapture estimates to the total population estimate. The sum of the individual estimates was not significantly different ($p < 0.05$) from the combined male/female total. The escapement of precocious males, calculated from the observed incidence of precocious males in the disk tag application sample (0.79%), was 92.

Peak spawner counts obtained during aerial and foot surveys were substantially less than the above estimate of total escapement (Appendix 8). The peak aerial count of 6,145 underestimated the actual escapement by 47%; the peak foot count of 3,276 obtained on December 5 and 6 underestimated the actual escapement by 72%. Both counts were well below the lower 95% confidence limit for the 1984 population estimate.

Biological Sampling

Age Composition: The age composition of coho salmon sampled on the spawning grounds is summarized in Table 13. Scale-age verification was completed on 929 samples, of which 29 were age 4_3, 899 were age 3_2 and 1 was age 3_3. Size selective sampling biases inherent to spawning ground surveys (discussed below) likely resulted in an underestimation of the precocious male (ages 3_3 and 2_2) component of the population. To correct this bias, the spawning ground age sample for adults was applied to the population estimate of 11,524 adults and 92 precocious males, producing an age composition of 3.1% age 4_3, 96.1% age 3_2 and 0.8% age 3_3 or 2_2.

Two unique growth patterns were noted in the fresh water residency period of age 4_3 coho. The first had closely spaced circuli in both the first and second years and a definite fresh water annulus; the second had finely spaced circuli in the first year and much wider spacing in the second year. These patterns suggest that a component of the age 4_3 Birkenhead River stock may leave the river and rear for extended periods in lacustrine or estuarine areas.

Length Distribution: Mean nose-fork lengths (NF) from disk tag application samples and mean postorbital-

Table 12. Population estimates of coho spawners in the Birkenhead River, 1984.

Group	Population estimates	95% confidence limits Upper	Lower
Males	5,795	6,911	4,856
Females	5,729	6,832	4,800
Adipose Clips	394	470	330
Total	11,524	13,743	9,656

Table 13. Sex and age composition and mean lengths of coho salmon captured for disk tag application and recovered on the spawning grounds (s = standard deviation).

Sample method	Age	Sex	Number sampled	Rel. percent	Mean length (cm)	s
Spawning ground recovery [1]	4_3	Male	9	1.0	49.2	6.80
		Female	20	2.1	52.8	5.33
	3_2	Male	446	48.0	49.6	6.55
		Female	453	48.8	53.0	4.37
	3_3	Male	1	0.1	29.5	-
	2_2	Male	0	-	-	-
	Total	Male	512	49.7	49.5	6.61
		Female	518	50.3	52.9	4.46
Disk tag application[2]	Total	Male	844	61.2	58.7	9.78
		Female	536	38.8	62.3	5.95
Disk tag recovery[2]	Total	Male	69	59.0	63.7	8.94
		Female	48	41.0	65.9	5.72

[1] Postorbital-hypural plate lengths.
[2] Nose-fork lengths.
Note - disk tag application samples were not adjusted for incorrect sex identification. Adjusted estimates are 60.0% males and 40.0% females.

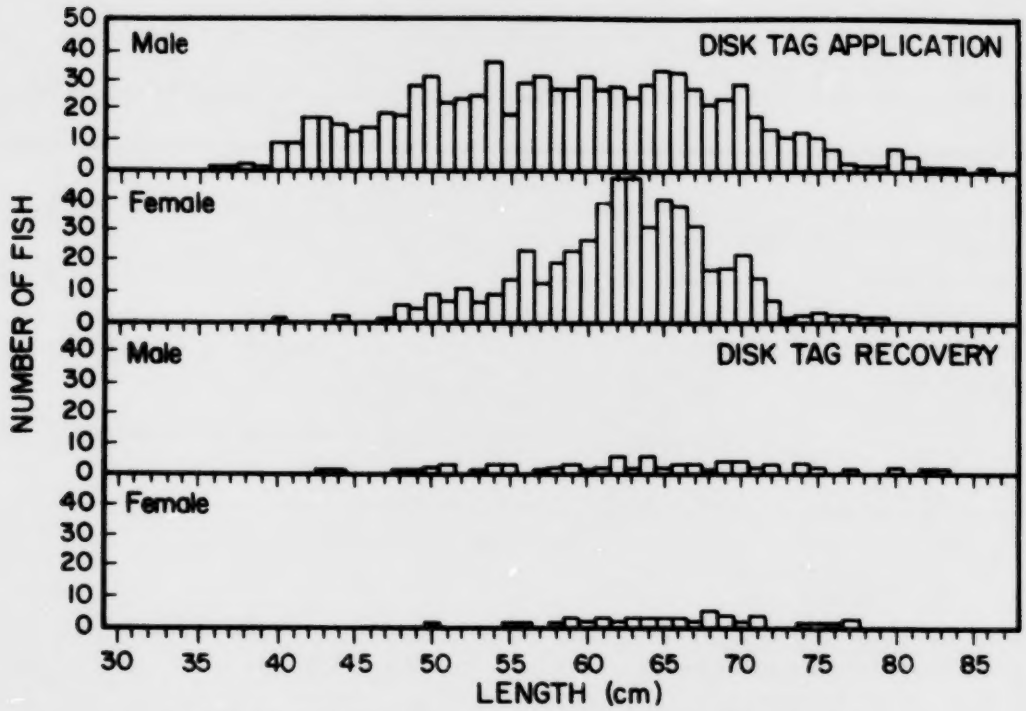

Figure 5 Nose-fork length frequency distributions by sex of Birkenhead River coho salmon which were disk tagged and subsequently recovered on the spawning grounds, 1984

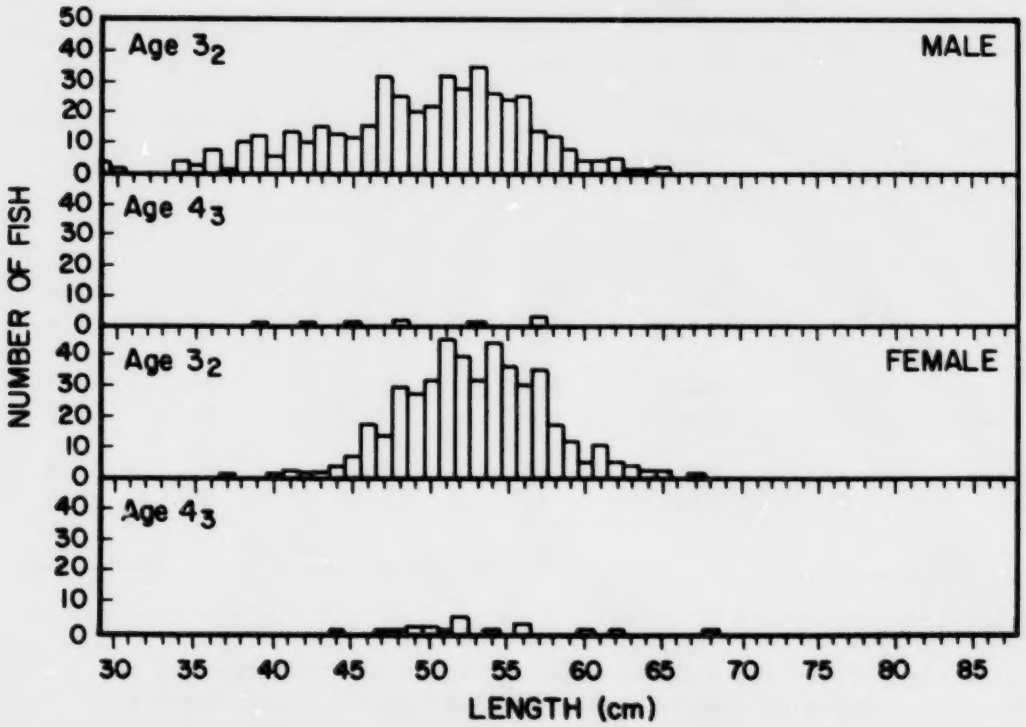

Figure 6 Postorbital-hypural plate length frequency distributions by sex and age of Birkenhead River coho salmon recovered on the spawning grounds, 1984

hypural plate lengths (POHL) from spawning ground samples are summarized in Table 13 and Figs. 5 and 6. POHL lengths of males and females averaged 49.5 ± 0.6 cm and 52.9 ± 0.4 cm. Mean POHL lengths of age 4_3 and 3_2 coho were not significantly different ($p < 0.05$) (Table 12).

NF lengths of males and females sampled during disk tag application averaged 58.7 ± 0.7 cm and 62.3 ± 0.5 cm respectively. NF lengths of disk tagged males and females subsequently recovered on the spawning grounds were significantly larger ($p < 0.05$), averaging 63.7 ± 2.1 cm and 65.9 ± 1.7 cm respectively, reflecting the size related bias in the recovery sample.

A significant correlation was noted between POHL and NF lengths of 69 males ($r = 0.91$; $p < 0.05$) and 48 females ($r = 0.86$; $p < 0.05$) which were disk tagged and subsequently recovered on the spawning grounds (Appendix 10). Predictive regressions for these data are as follows:

Adult Males:	POHL= 0.69 NF + 6.32
	NF = 1.31 POHL - 2.40
Adult Females:	POHL= 0.71 NF + 7.06
	NF = 1.22 POHL + 0.34

Sex Ratio: Adult males and females comprised 60.0% and 40.0% respectively of the disk tag application sample, 49.7% and 50.3% respectively of the spawning ground sample (Table 13) and 50.3% and 49.7% respectively of the final Petersen population estimate (Table 12). Precocious males comprised 0.8% of the disk tag application sample and 0.1% of the spawning ground sample.

Coded Wire Tag Recoveries

The incidence of coho adults with adipose clips was higher in the spawning ground sample than in the disk tag application sample, totalling 7.7% and 5.1% respectively (Appendices 8 and 9). Due to unquantified sampling biases associated with both samples, neither ratio was used to estimate the total return of adipose clipped coho. Instead, a total return of 394 adipose clipped coho was estimated by applying the ratio of the individual mark-recapture population estimates of adipose clipped and unclipped coho to the pooled mark-recapture estimate.

A total of 79 adipose clipped carcasses were recovered during spawning ground surveys in 1984 (Appendices 8 and 11; Table 14). Of those, dissection yielded 64 with code 02 22 09, six with code 02 23 26, seven without a CWT and two CWT's which were lost during processing. The estimated total return by tag code was determined by applying the above proportions to the estimated return of adipose clipped coho, yielding 327 code 02 22 09 and 31 code 02 23 26.

Age at return was estimated as 98.2% and 83.3% age 3_2 for codes 02 22 09 and 02 23 26 respectively, the remainder being age 4_3 (Table 15). The age composition of code 02 22 09 was not significantly different ($p < 0.05$; difference in proportions test) than expected from the age sample at release. The age composition of code 02 23 26 was significantly different ($p < 0.05$) at recovery, however, with more younger individuals observed.

CWT Loss: The incidence of CWT loss in the 79 adipose clipped spawning ground recoveries was 9.1% (Table 14). It was not possible to assess the impact of carcass condition on CWT loss due to the uniformity in carcass condition; however, the incidence of CWT loss was not significantly ($p < 0.05$) influenced by the activities of predators (Table 16).

Estimated Survival: Before calculating the survival from juvenile release to spawning ground recovery, the release data were adjusted to reflect the long term incidence of CWT loss of 9.1%. The estimated survival

Table 14. Summary of juvenile releases, spawning ground recoveries and survival by CWT code in the Birkenhead River, 1984.

Code	Number released*	Spawning ground recoveries		Estimated total return	Survival (%)
		Number	%		
02 22 09	39,754	64	83.1	327	0.82
02 23 26	3,125	6	7.8	31	0.99
No Tag	4,293	7	9.1	36	-
** Tag lost	N/A	2	-	-	-
Total	-	79	-	394	-

* Adjusted for long term tag loss.
** Spawning ground recoveries only; tag originally present but lost prior to or during dissection.

Table 15. Coho age composition by CWT code at release and recovery in the Birkenhead River system.

Code	Age at release			Age at recovery		
	n	Age 0+	Age 1+	n	Age 3_2	Age 4_3
02 22 09	281	100.0	0.0	56	98.2	1.8
02 23 26	197	42.2	57.8	6	83.3	16.7

Table 16. Incidence of CWT loss by carcass condition and eye status in adult coho carcasses recovered on the Birkenhead River spawning grounds, 1984.

Group	Sample size	CWT absent	CWT loss (%)
Condition 1	1	0	0.0
Condition 2	7	1	14.3
Condition 3	66	5	7.6
Condition 4	3	1	33.3
Eyes present	64	6	9.4
Eyes absent	13	1	7.3

(and 95% confidence limits) from juvenile release to adult recovery for codes 02 22 09 and 02 23 26 was 0.82% (0.69% to 0.98%) and 0.99% (0.83% to 1.18%) respectively (Table 14). These survivals do not include jack returns, fishery recoveries or returns of age 4_3 adults in 1985/6.

DISCUSSION

JUVENILE AGE CLASS SEPARATION

Considerable difficulties were encountered during the study in correctly sorting coho juveniles by age class. As a result, approximately 42% of the age 1+ CWT group consisted of age 0+ juveniles. This reflected in part both staff inexperience and the comparatively crude technique used to measure eye diameter; however, the error may also be attributed to a large amount of overlap between age classes in both eye diameter and body size. In a similar study in the upper Pitt River system, it was concluded that when considerable overlap existed in morphological features, a subjective technique involving both body length and eye size was considerably more effective than a fixed point cut-off using a single morphological feature (Schubert and Fedorenko 1985). This technique may have proved more effective in the Birkenhead study.

DELAYED TAG LOSS

The observed increase in the incidence of CWT loss with time in Birkenhead River coho salmon (Table 17) was consistent with assessments in U.S. hatcheries which reported that CWT loss was virtually complete within one month of tag application (Bergman *et al.* 1968; Blankenship 1981). The final level of CWT loss of 9.1% was virtually indentical to the levels reported in coho spawning ground recoveries in the upper Pitt River (9.2%) (Schubert and Fedorenko 1985) and in the Cowichan-Koksilah River (9.3%) (Lister *et al.* 1981). Estimates of short term CWT loss in these studies ranged from 0.4% to 3.7% suggesting that, within limits, long term CWT loss may be independent of CWT loss assessed after 24-hours. This suggests that, while assessment of short term CWT loss may provide important feed-back regarding CWT machine and operator performance, it does not provide useful projections of the level of CWT loss during the period of recruitment to the fisheries.

Table 17. Incidence of CWT loss in Birkenhead River coho salmon over short (24-hours), intermediate (up to 60 days after tagging) and long (adult recovery) time periods. Sample sizes are bracketed.

Code	CWT loss (%)		
	Short term	Intermediate	Long term
02 22 09	0.4 (5,265)	1.0 (670)	-
02 23 26	0.2 (2,278)	7.7 (26)	-
*Mean	0.4 (7,543)	1.5 (696)	9.1 (79)

* Weighted by tag lot size.

RUN TIMING

Previous assessments of coho run timing in the Birkenhead River have reported considerably earlier timing than observed in 1984. Fishery officers reported the start, peak and completion of spawning occurred in late October, mid November and early December respectively (Brown **et al.** 1979). A more intensive assessment during 1982 reported the start, peak and completion of spawning occurred in late October, late November/early December and late January respectively (Cook MS 1983), approximately 1 to 4 weeks earlier than the timing observed in 1984. While run timing during 1984 may have been somewhat late, the results of the more intensive surveys conducted during 1982 and 1984 suggest that previous reports of run timing may have been in error.

POPULATION ESTIMATES

Sampling Selectivity

An evaluation of bias in the disk tag application sample indicated that the angling gear used by this study was selective toward males but was not selective with respect to size. The apparent lack of size selective bias was generally consistent with results reported in the literature. Leclerc and Power (1980) reported that fly fishing was the least selective of four different gears in sampling brook char (**Salvelinus fontinalis**) and ouananiche (**Salmo salar**) in a Quebec River. Bryan (1974) observed no selective bias when sampling Artic grayling (**Thymallus articus**) using spinners with fluorescent orange wool but reported the same gear select larger Artic char (**Salvelinus alpinus**). Leclerc and Power (1980) defined the selective range of angling gear at the lower limit by the largest hook and bait a small fish can take in it's mouth and at the upper limit by the smallest size of prey of interest to a large fish and by the ability of the hook to hold a large fish without tearing or breaking. The hook size and lure used in the Birkenhead study were considered appropriate to the entire adult coho size range; however, gear selection could not address sampling biases associated with aggression or social heirarchy which may have resulted in the selective bias toward males.

In contrast to the application sample, the spawning ground recovery sample was unbiased by sex but significantly biased toward larger fish. The apparant lack of sex related recovery bias contrasts with other studies which have reported substantially higher spawning ground recovery rates of females in coho (Eames and Hino 1981; Eames **et al.** 1981), pink (Ward 1959) and sockeye (Petersen 1954) which were attributed to sex related behavioral differences. The equal recovery rates observed in Birkenhead River coho likely reflect the extremely low flows during the spawning period and the concentration of spawning in protected side channel and tributary areas. Both factors would tend to minimize displacement downstream by males, the factor most commonly cited as the cause of lower recovery rates in males.

It is unlikely that sample selectivity resulted in a biased population estimate in the 1984 Birkenhead River study. Junge (1963) demonstrated that selectivity can exist in both application and recovery samples without introducing population estimation biases if the sources of selectivity are independent, and if the source of of selectivity in the recovery sample is independent of mark status. Both conditions were met in the Birkenhead River study.

Three general conclusions can be drawn from the above. First, despite size and sex related sampling selectivity, it is unlikely that the 1984

population estimate was biased. Second, spawning ground enumeration samples are size selective and provide biased estimates of the size-frequency distribution and other parameters of the population. Third, when spawning ground surveys are used for the census sample in mark-recapture studies, it becomes important to eliminate selectivity in the mark application sample or to ensure that the biases in the two samples are dissimilar. The use of angling gear for disk tag application is well suited to this type of study due to an absence of size selective bias and to a sex selective bias which is opposite to that reported in most spawner surveys.

CWT Return

The incidence of adipose marked coho in the spawning ground sample (7.7%) was substantially higher than in the population (3.4%). This bias resulted from a higher recovery rate of adipose marked individuals (Table 7) which may have reflected behavioral differences between the mainstem and tributary/side channel components of the stock. Juvenile trapping efforts focused on high density rearing areas in side channels and tributaries rather than in mainstem areas where rearing was more dispersed. Adult carcasses were likely recovered at a higher rate in these areas due to a lower rate of downstream displacement during high flows. If a relationship existed between spawning location and late summer rearing area, the above factors could result in a higher recovery rate of adipose marked coho. Studies which apply CWT's to rearing juveniles should, therefore, avoid estimating spawning ground return by applying the observed CWT incidence in the spawning ground recovery sample to an independent population estimate.

SUMMARY

1. A coded wire tag assessment of Birkenhead River coho salmon was conducted to document the exploitation rate, catch distribution and survival rate of this stock. Juvenile coho salmon were captured with minnow traps and coded wire tagged during the period September 15 to November 18, 1982. Adult spawners were enumerated by a mark-recapture study conducted during the period October 30, 1984 to January 6, 1985.

2. A total of 44,875 age 0+ and 3,553 age 1+ coho were adipose clipped and coded wire tagged. When adjustments were made for short term (24-hour) CWT loss, poor clip quality and mortality, an estimated 43,566 age 0+ coho (code 02 22 09) and 3,432 age 1+ coho (code 02 23 26) were released with adipose clips and coded wire tags.

3. The incidence of coded wire tag loss was assessed over short (24-hour), intermediate (up to two month) and long (two years) time periods. Tag loss increased from the short term incidence of 0.4%, to an intermediate incidence of 1.5%, and to a final spawning ground incidence of 9.1%. The final incidence of tag loss appeared unrelated to the incidence at release.

4. Coho juveniles were sorted by age class using a fixed point cutoff in eye diameter. Sample results at release indicated that the age 0+ code was composed entirely of age 0+ fish, and the age 1+ code was composed of 42% age 0+ and 58% age 1+ coho.

5. Age 0+ coho released with CWT's averaged 55.8 mm and 1.99 g. Age 1+ coho averaged 84.7 mm and 7.02 g.

6. The 1984 spawner escapement was estimated from a disk tag application sample of 1,364, a census sample of 1,029 and a recovery of 121 disk tagged coho. The escapement was estimated at 11,524 adult coho, of which 5,795 were males, 5,729 were females and 394 were adipose clipped. A further 92 precocious males also returned in 1984.

7. The estimated return to the spawning grounds of codes 02 22 09 and 02 23 26 were 327 and 31 respectively. Survival from release to spawning ground recovery (excluding fishery catch and returns of precocious males) was 0.82% for code 02 22 09 and 0.99% for code 02 23 26.

8. The age composition of the 1984 spawner escapement was 3.1% age 4_3, 96.1% age 3_2 and 0.8% precocious male.

9. Postorbital-hypural plate lengths of male and female coho salmon recovered on the spawning grounds averaged 49.5 cm ± 0.6 cm and 52.9 cm ± 0.4 cm respectively. No difference was noted in the mean length of age 4_3 and 3_2 recoveries.

10. The angling gear used to obtain the disk tag application sample was biased toward males but unbiased with respect to fish size. The spawning ground recovery sample was biased toward larger fish but unbiased with respect to sex. These sampling biases, however, did not bias the final population estimate.

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APPENDICES

APPENDIX 1. MONTHLY AND ANNUAL MEAN DAILY DISCHARGES (CUBIC METERS PER SECOND) IN THE BIRKENHEAD RIVER NEAR MOUNT CURRIE (STATION NO. 08MG008), 1946 TO 1971*.

YEAR	MEAN DAILY DISCHARGE (CMS)													MAXIMUM DAILY DISCHARGE		MINIMUM DAILY DISCHARGE	
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	CMS	DATE	CMS	DATE
1946	4.35	3.84	5.93	12.70	-	-	42.30	24.70	13.30	5.71	2.86	3.45	-	-	-	2.55	NOV 25
1947	3.25	5.66	7.69	18.80	47.30	42.70	35.40	19.70	12.90	9.30	7.01	6.69	18.10	53.80	MAY 27	2.72	FEB 05
1948	6.15	-	3.98	10.20	-	-	37.40	24.60	19.50	21.00	-	-	-	-	-	-	-
1949	-	-	4.29	13.10	42.50	51.40	-	-	11.80	7.79	-	-	-	-	-	-	-
1950	-	-	6.51	6.95	35.50	73.80	71.60	37.30	27.80	14.80	23.00	23.20	-	114.00	JUN 13	-	-
1951	-	-	-	21.20	48.70	66.20	61.90	20.60	12.20	11.60	7.10	6.29	-	92.00	JUL 03	-	-
1952	4.49	5.50	4.64	13.20	45.60	58.30	51.10	23.80	11.20	8.14	6.10	4.72	19.80	93.40	JUN 05	4.13	NOV 24
1953	7.74	9.25	6.62	12.00	45.70	53.20	50.90	24.30	13.70	17.30	19.50	12.30	22.80	77.60	JUL 11	4.47	JAN 01
1954	9.33	10.40	7.84	9.54	38.50	62.00	70.50	43.00	25.20	17.10	34.80	17.90	29.00	98.00	JUL 01	6.77	MAR 31
1955	9.01	7.18	5.58	8.94	20.20	71.40	102.00	37.40	18.60	20.60	17.80	7.27	27.30	173.00	JUL 21	4.42	DEC 31
1956	3.23	2.79	3.14	17.20	57.00	62.30	56.90	25.60	19.90	-	10.40	-	-	96.80	MAY 20	2.72	MAR 03
1957	-	4.72	4.16	11.40	73.00	68.30	36.50	19.20	18.90	7.93	6.85	7.18	-	95.40	JUN 05	3.57	FEB 22
1958	7.61	8.27	8.90	11.60	63.90	73.00	28.50	15.50	12.60	19.60	12.70	16.20	23.30	129.00	MAY 28	5.38	FEB 16
1959	9.52	5.20	5.34	15.00	44.80	65.90	58.40	23.60	17.90	18.40	10.40	8.45	23.70	96.30	JUN 21	3.06	MAR 17
1960	4.36	3.90	6.65	15.30	31.50	64.20	55.40	25.50	13.40	13.40	10.10	8.57	21.10	88.90	JUL 08	3.26	JAN 20
1961	12.10	12.70	12.00	13.70	51.80	94.40	59.10	27.80	13.70	16.50	8.36	5.56	27.40	142.00	JUN 04	4.62	DEC 16
1962	8.29	11.60	5.14	14.40	27.90	62.30	42.80	26.90	12.30	17.20	19.20	19.00	22.30	104.00	JUN 16	4.47	MAR 28
1963	10.00	28.60	11.00	9.66	35.20	67.20	46.10	23.00	14.80	19.10	20.10	15.40	25.00	98.00	JUN 17	6.51	JAN 23
1964	12.50	7.73	5.97	10.00	23.70	78.70	70.80	32.50	20.00	20.40	16.50	9.40	25.70	126.00	JUL 08	5.35	MAR 26
1965	5.59	5.74	9.40	16.90	37.20	58.90	42.90	22.60	8.24	20.90	28.00	10.40	22.30	114.00	NOV 03	4.73	JAN 24
1966	7.49	4.28	14.30	24.30	33.50	64.00	62.70	21.00	14.70	14.80	10.70	15.20	24.00	96.60	JUL 08	3.94	MAR 01
1967	7.55	8.38	7.34	7.44	34.30	129.00	47.70	20.60	12.50	21.60	23.00	11.70	27.60	278.00	JUN 22	5.95	JAN 14
1968	20.60	14.00	19.80	11.70	28.70	74.80	87.50	35.60	21.90	19.40	20.10	26.00	31.80	362.00	JUN 27	8.04	OCT 17
1969	-	-	-	23.70	67.80	118.00	45.00	21.00	18.30	16.50	10.60	7.80	-	163.00	JUN 15	-	-
1970	6.18	5.33	5.99	8.54	19.10	65.50	26.10	15.40	11.90	7.15	5.75	4.75	15.10	91.50	JUN 08	4.22	DEC 22
1971	5.53	8.96	6.65	8.83	61.00	70.20	66.70	-	-	-	-	-	-	-	-	-	-
MEAN	8.03	8.29	7.45	13.32	42.27	70.65	54.25	25.47	15.89	15.26	14.39	11.25	23.90	-	-	-	-

* FROM ENVIRONMENT CANADA (1980).

APPENDIX 2. SUMMARY OF SALMON ESCAPEMENTS TO THE BIRKENHEAD RIVER SYSTEM. 1951 TO 1983 (UNLESS OTHERWISE NOTED. ALL ESTIMATES FROM FISHERY OFFICER FILES).

YEAR	CHINOOK	SOCKEYE ‡	PINK	COHO	CHUM	STEEL-HEAD
1951	750	42063	-	750	-	-
1952	750	77386	-	15750	-	-
1953	1500	55823	-	3700	-	-
1954	750	40453	-	825	-	-
1955	750	24450	-	1700	-	-
1956	750	57899	-	3525	-	-
1957	3500	24168	-	1550	-	-
1958	750	33055	-	2075	-	-
1959	750	38604	-	2025	-	-
1960	750	39848	-	3525	-	-
1961	750	49627	-	2575	-	-
1962	750	52146	-	2575	-	-
1963	750	67151	-	3575	-	-
1964	750	69939	-	3700	-	-
1965	750	30008	-	3700	-	-
1966	750	81134	-	3700	-	-
1967	750	58036	-	3200	-	-
1968	750	83750	-	3700	-	-
1969	1000	64527	-	1670	-	-
1970	1500	72760	-	3400	-	-
1971	250	32672	-	4200	-	-
1972	400	113097	-	3700	-	-
1973	200	139295	-	1700	-	-
1974	400	173463	-	7700	-	-
1975	200	92928	-	3900	-	-
1976	200	108121	-	1575	-	-
1977	600	43139	-	1575	-	-
1978	400	99857	-	3900	-	-
1979	200	78088	-	3575	-	-
1980	300	90922	-	1600	-	-
1981	100	65495	17	3200	-	-
1982	400	128771	-	3600	-	-
1983	550	48841	-	1050	-	-
AVERAGE						
51-60	1100	43375	0	3543	0	0
61-70	850	62908	0	3180	0	0
71-80	315	97158	0	3343	0	0
79-83	310	82423	17	2605	0	0

‡ IPSFC ESTIMATES.

APPENDIX 3a. TAGGING RESULTS FOR AGE 0+ COHO, BIRKENHEAD RIVER SYSTEM, 1982 (CODE 02 22 09).

CAPTURE LOCATION	TAGGING DATE	PRE-TAGGING MORTALITY*	RELEASED WITHOUT TAGGING **	TOTAL NUMBER MARKED	24 HOUR REJECT RATE		TOTAL MARKED AND WITHOUT CWTS		POST TAGGING MORTALITY		CWT AND NO ADIPOSE CLIP		TOTAL RELEASED WITH ADIPOSE CLIPS AND CWTS
					N ***	%	ADIPOSE ONLY	****TAG LOST	IMMEDIATE	*****24 HOUR	NUMBER ******	%	
REACH #7, #8, #9	SEP 20	15	60	2189	0	0.40	0	9	0	0	49	2.26	2131
REACH #7, #8, #9	SEP 21	24	112	2912	350	0.29	0	8	1	0	66	2.26	2837
REACH #7, #8, #9	SEP 22	5	677	3109	350	0.00	0	0	0	16	9	0.29	3084
REACH #7, #8, #9	SEP 23	6	153	1871	0	0.40	0	7	0	3	42	2.26	1819
REACH #7, #8, #9	SEP 24	4	127	1695	0	0.40	0	7	1	0	38	2.26	1649
REACH #7	SEP 29	2	315	2387	350	0.57	0	14	0	4	34	1.43	2335
REACH #7	SEP 30	19	380	3239	350	0.57	0	18	0	8	64	2.00	3149
REACH #7	OCT 01	8	476	1987	0	0.40	0	8	0	0	45	2.26	1934
REACH #7	OCT 07	6	531	2990	350	0.86	0	26	4	0	17	0.57	2943
REACH #7	OCT 13	7	636	1515	357	0.28	0	4	1	0	0	0.00	1510
REACH #7	OCT 14	5	664	1700	350	0.29	0	5	0	2	63	3.71	1630
REACH #7	OCT 15	8	704	1780	350	0.00	0	0	0	0	142	8.00	1638
REACH #7	OCT 18	16	549	1347	350	0.57	0	7	0	109	46	3.71	1185
REACH #7	OCT 21	6	655	1486	353	0.86	0	12	0	30	8	0.57	1436
REACH #5	OCT 27	7	286	431	0	0.40	0	2	0	0	10	2.26	419
REACH #5	OCT 28	2	498	2169	350	0.00	0	0	0	3	50	2.29	2116
REACH #5	OCT 29	1	8	77	0	0.40	0	0	0	0	2	2.26	75
REACH #6	NOV 03	3	293	1751	355	1.13	0	20	0	0	34	1.97	1697
REACH #6	NOV 04	5	296	2155	350	0.00	0	0	0	1	62	2.86	2092
REACH #6	NOV 05	4	150	1624	350	0.00	0	0	0	1	37	2.29	1586
REACH #2	NOV 18	3	0	3898	350	0.29	0	11	1	0	78	2.00	3808
REACH #2	NOV 19	3	0	2563	0	0.40	0	10	2	0	58	2.26	2493
TOTAL	-	159	7570	44875	5265	0.40	0	168	10	177	954	2.26	43566

* SACRIFICED FOR TAG PLACEMENT ASSESSMENT, AND PEN MORTALITIES.

** ANOMALIES (SEE APPENDIX 4) AND UNDERSIZE (<45 MM) FISH.

*** SIZE OF SAMPLE HELD FOR TAG LOSS, MORTALITY, ANOMALY AND CLIP QUALITY ASSESSMENT (24-HOURS IN MINIMUM HOLDING TIME).

**** BASED ON APPLICATION OF % REJECT RATE TO ENTIRE TAG LOT (ANNUAL AVERAGE USED WHEN NO QCD SUBSAMPLE HELD).

***** OBSERVER PRIOR TO RELEASE IN ENTIRE TAG LOT.

****** INCIDENCE OF MISSED CLIPS IN QCD SUBSAMPLE APPLIED TO ENTIRE TAG LOT (ANNUAL AVERAGE USED WHEN NO QCD SUBSAMPLE HELD).

APPENDIX 3b. TAGGING RESULTS FOR AGE 1+ COHO JUVENILES, BIRKENHEAD RIVER SYSTEM, 1982 (02 23 26).

LOCATION	TAGGING DATE	PRE-TAGGING MORTALITY*	RELEASED WITHOUT TAGGING **	TOTAL NUMBER MARKED	24 HOUR REJECT RATE		TOTAL MARKED AND WITHOUT TAGS		POST TAGGING MORTALITY		CWT AND NO ADIPOSE CLIP		TOTAL RELEASED WITH ADIPOSE CLIPS AND CWTS
					N ***	%	ADIPOSE ONLY	****TAG LOST	IMMEDIATE	*****24 HOUR	NUMBER *****	%	
REACH 07, 08, 09	SEP 23	2	0	620	351	0.28	0	2	0	0	4	0.57	614
REACH 07, 08, 09	SEP 24	2	0	260	0	0.18	0	0	0	0	8	3.07	252
REACH 07	OCT 01	4	0	226	224	0.45	0	1	0	0	1	0.45	224
REACH 07	OCT 07	1	0	278	276	0.36	0	1	0	1	1	0.36	275
REACH 07	OCT 14	2	0	352	348	0.00	0	0	0	0	16	4.60	336
REACH 07	OCT 18	7	1	431	350	0.00	0	0	0	12	12	2.86	407
REACH 07	OCT 22	1	0	173	0	0.18	0	0	0	0	5	3.07	168
REACH 05	OCT 27	1	0	52	0	0.18	0	0	0	0	2	3.07	50
REACH 05	OCT 28	1	0	195	195	0.00	0	0	0	0	1	0.51	194
REACH 05	OCT 29	1	0	13	0	0.18	0	0	0	0	0	3.07	13
REACH 06	NOV 04	2	0	292	292	0.34	0	1	0	0	27	9.25	264
REACH 06	NOV 05	3	0	247	242	0.00	0	0	0	0	12	4.96	235
REACH 02	NOV 19	3	0	414	0	0.18	0	1	0	0	13	3.07	400
TOTAL	-	30	1	3553	2278	0.18	0	6	0	13	102	3.07	3432

* SEE APPENDIX 3A FOR FOOTNOTE NOTATIONS.

APPENDIX 3C. RECAPTURES OF TAGGED COHO JUVENILES IN THE BIRKENHEAD RIVER SYSTEM. 1982.

INSPECTION DATE	AGE 0+			AGE 1+		
	NUMBER RECAPTURED	NUMBER WITHOUT CWT	CWT LOSS RATE (%)	NUMBER RECAPTURED	NUMBER WITHOUT CWT	CWT LOSS RATE (%)
SEPTEMBER 29	35	1	2.86	0	-	-
SEPTEMBER 30	55	2	3.64	0	-	-
OCTOBER 1	43	1	2.33	1	0	0.00
OCTOBER 7	83	0	0.00	1	0	0.00
OCTOBER 13	93	0	0.00	0	-	-
OCTOBER 14	46	0	0.00	3	0	0.00
OCTOBER 15	35	0	0.00	0	-	-
OCTOBER 18	25	2	8.00	3	0	0.00
OCTOBER 22	0	-	-	12	2	16.67
OCTOBER 27	122	0	0.00	1	0	0.00
OCTOBER 28	133	1	0.75	0	-	-
NOVEMBER 5	0	-	-	5	0	0.00
TOTAL	670	7	1.04	26	2	7.69

APPENDIX 4a. INCIDENCE OF POOR ADIPOSE CLIPS AND OF ANOMALIES ENCOUNTERED IN THE AGE 0+ QCD SAMPLE IN THE BIRKENHEAD RIVER SYSTEM. 1982 (FIRST NUMBER INDICATES MINOR ANOMALY RELEASED TAGGED: SECOND NUMBER INDICATES SEVERE ANOMALY RELEASED UNTAGGED).

CAPTURE LOCATION	TAGGING DATE	NUMBER IN-SPECTED	REJECTED ADIPOSE CLIPS			FOG EYE	POP EYE	EYE DAMAGE	FIN ROT	TAIL DAMAGE	NOSE DAMAGE	OPER-CULUM DAMAGE	GENERAL DAMAGE	SCALE LOSS	LORD-OSIS	SCOLI-OSIS	NATUR-ALLY MISSING ADIPOSE
			NO CLIP	PARTIAL CLIP	%												
REACHES 07. 08. 09	SEP 22	350	0	1	0.29	-	-	-	-	-	-	-	-	1/0	-	-	3
REACH 07	SEP 29	350	1	4	1.43	-	-	-	-	1/0	-	-	2/1	-	-	-	-
REACH 07	SEP 30	350	0	7	2.00	-	0/1	-	-	-	-	-	-	-	-	-	-
REACH 07	OCT 07	350	0	2	0.57	-	-	-	-	-	-	-	4/2	3/0	-	-	-
REACH 07	OCT 13	357	0	0	0.00	-	-	-	0/2	1/0	-	-	1/0	-	-	0/1	-
REACH 07	OCT 14	350	6	7	3.71	-	-	-	1/0	1/0	-	1/0	2/0	-	-	-	-
REACH 07	OCT 15	350	1	27	8.00	-	-	-	2/1	2/0	4/0	-	1/2	-	-	-	-
REACH 07	OCT 18	350	1	12	3.71	-	0/1	1/0	-	-	2/0	0/1	3/0	-	-	-	-
REACH 07	OCT 21	353	0	2	0.57	-	-	1/0	-	1/0	-	-	2/1	1/0	-	-	-
REACH 05	OCT 28	350	1	7	2.29	-	-	1/0	-	2/0	-	-	10/1	2/0	-	-	-
REACH 06	NOV 03	355	0	7	1.97	-	-	-	-	1/0	-	-	1/0	-	-	-	-
REACH 06	NOV 04	350	1	9	2.86	-	-	-	-	-	-	-	2/0	1/0	-	-	-
REACH 06	NOV 05	350	1	7	2.29	-	-	-	-	-	2/0	-	5/0	1/0	-	-	-
REACH 02	NOV 18	350	0	7	2.00	-	-	-	-	-	-	-	1/0	1/0	-	-	-
TOTAL		4915	12	99	-	-	0/2	3/0	3/3	9/0	8/0	1/1	34/7	10/0	-	0/1	3
% INCIDENCE (UNWEIGHTED)		-	0.24	2.01	2.26	0.00	0.04	0.06	0.12	0.18	0.16	0.04	0.83	0.20	0.00	0.02	0.06

APPENDIX 4b. INCIDENCE OF POOR ADIPOSE CLIPS AND OF ANOMALIES ENCOUNTERED IN THE AGE 1+ QCD SAMPLE IN THE BIRKENHEAD RIVER SYSTEM, 1982 (FIRST NUMBER INDICATES MINOR ANOMALY RELEASED TAGGED: SECOND NUMBER INDICATES SEVERE ANOMALY RELEASED UNTAGGED).

CAPTURE LOCATION	TAGGING DATE	NUMBER IN-SPECTED	REJECTED ADIPOSE CLIPS			FOG EYE	POP EYE	EYE DAMAGE	FIN ROT	TAIL DAMAGE	NOSE DAMAGE	OPER-CULUM DAMAGE	GENERAL DAMAGE	SCALE LOSS	LORD-OSIS	SCOLI-OSIS	NATUR-ALLY MISSING ADIPOSE
			NO CLIP	PARTIAL CLIP	%												
REACHES 07, 08, 09	SEP 23	351	0	2	0.57	1/0	-	-	-	-	129/0	-	4/0	10/0	-	-	-
REACH 01	OCT 01	224	0	1	0.45	-	-	-	-	-	16/0	-	2/0	4/0	-	-	-
REACH 01	OCT 07	276	0	1	0.36	1/0	-	-	-	1/0	1/0	-	3/0	9/0	-	-	-
REACH 01	OCT 14	348	0	16	4.60	-	-	-	-	-	52/0	0/1	-	4/0	-	-	-
REACH 01	OCT 18	350	1	9	2.86	-	-	-	-	1/0	112/0	-	2/2	1/0	-	-	-
REACH 05	OCT 28	195	0	1	0.51	-	-	-	-	1/0	-	-	-	2/0	-	-	-
REACH 06	NOV 04	292	1	26	9.25	-	-	-	-	1/0	-	1/0	12/0	12/0	0/1	-	-
REACH 06	NOV 05	242	0	12	4.96	-	-	-	-	-	29/0	1/0	1/0	1/0	-	-	-
TOTAL		2278	2	68	-	2/0	-	-	-	4/0	339/0	2/1	24/2	43/0	0/1	-	-
% INCIDENCE (UNWEIGHTED)		-	0.09	2.99	3.07	0.09	0.00	0.00	0.00	0.18	14.88	0.13	1.14	1.89	0.04	0.00	0.00

APPENDIX 5. LENGTH FREQUENCY DISTRIBUTION OF COHO JUVENILES RELEASED WITH CWT'S AND PROPORTIONS OF EACH AGE CLASS TAGGED WITH AGE 0+ AND 1+ CWT CODES. BY CAPTURE SITE. IN THE BIRKENHEAD RIVER SYSTEM. 1982.

CAPTURE SITE:	REACH #8			REACH #8			REACH #7			REACH #7			REACH #7			REACH #5		
DATE:	SEP 21			SEP 23			OCT 01			OCT 08			OCT 18			OCT 29		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (mm)																		
31-35	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36-40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
41-45	9	-	9	9	-	9	13	-	14	-	-	-	4	-	4	1	-	1
46-50	13	-	13	11	-	14	15	-	16	15	-	17	13	-	13	12	-	12
51-55	9	-	11	10	-	15	13	-	14	8	-	10	6	-	6	9	-	11
56-60	4	-	5	5	-	6	4	-	4	12	-	13	11	-	11	9	-	9
61-65	7	-	8	-	-	1	1	-	2	2	-	4	8	-	8	10	-	10
66-70	1	-	1	1	1	3	2	-	2	3	1	6	5	-	7	3	-	4
71-75	2	-	2	3	9	14	2	-	2	4	4	8	1	-	3	9	4	13
76-80	-	-	-	5	10	22	14	-	14	1	7	11	1	-	4	2	3	5
81-85	-	-	-	4	9	26	17	-	17	2	10	16	-	-	12	5	6	11
86-90	-	-	-	1	11	16	11	-	11	-	4	6	1	-	12	1	5	10
91-95	-	-	-	-	5	9	1	-	1	-	3	5	-	-	9	1	5	9
96-100	-	-	-	-	9	12	-	1	1	-	-	1	-	-	5	-	1	2
101-105	-	-	-	-	2	2	-	2	2	-	-	1	-	1	6	-	2	2
106-110	-	-	-	-	1	1	-	-	-	-	1	2	-	-	-	-	-	-
111-115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	46	0	50	49	57	150	93	3	100	47	30	100	50	1	100	63	26	100
NO. TAGGED WITH 0+ CODE (02 22 09)	46	-	-	40	0	-	46	0	-	42	0	-	49	0	-	48	0	-
NO. TAGGED WITH 1+ CODE (02 23 26)	0	-	-	9	57	-	47	3	-	5	30	-	1	1	-	15	26	-

* OCCASIONAL DISCREPANCY IN COLUMN ADDITION DUE TO SCALE REGENERATION.

CONTINUED

APPENDIX 5 CONTINUED.

CAPTURE SITE:	REACH 86			WARBONNET CR			TOTAL		
DATE:	NOV 08			NOV 19					
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (mm)									
31-35	-	-	-	-	-	-	1	0	1
36-40	-	-	-	-	-	-	1	0	1
41-45	-	-	1	-	-	-	36	0	38
46-50	3	-	8	-	-	-	82	0	93
51-55	-	-	8	2	-	7	57	0	82
56-60	2	-	12	1	-	13	48	0	73
61-65	-	-	4	1	-	10	29	0	47
66-70	-	-	10	-	-	12	15	2	45
71-75	1	-	8	-	-	12	22	17	62
76-80	1	-	13	1	-	13	25	20	82
81-85	-	-	16	-	-	15	28	25	113
86-90	-	-	10	-	-	11	14	20	76
91-95	-	-	7	-	-	4	2	13	44
96-100	1	-	3	-	-	1	1	11	25
101-105	-	-	-	-	-	1	0	7	14
106-110	-	-	-	-	-	1	0	2	4
111-115	-	-	-	-	-	-	0	0	0
TOTAL	8	0	100	5	0	100	361	117	800
NO. TAGGED WITH 0+ CODE (02 22 09)	6	0	-	4	0	-	281	0	-
NO. TAGGED WITH 1+ CODE (02 23 26)	2	0	-	1	0	-	80	117	-

APPENDIX 6. LENGTH FREQUENCY DISTRIBUTION (AGE 0+ AND 1+) AND MEAN WET WEIGHTS OF COHO JUVENILES CAPTURED IN THE BIRKENHEAD RIVER SYSTEM, 1982.

LOCATION:	REACH 08			REACH 06			REACH 07			REACH 05			REACH 02			REACH 01		
DATE:	AUG 19			AUG 20			AUG 20			AUG 21			AUG 23			AUG 25		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)																		
31-35	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-
36-40	9	-	10	1	-	1	1	-	1	8	-	8	4	-	4	-	-	-
41-45	21	-	21	6	-	6	5	-	5	13	-	13	5	-	5	2	-	2
46-50	15	-	15	19	-	19	5	-	5	9	-	11	2	-	2	4	-	4
51-55	12	-	12	13	-	13	11	-	11	6	-	6	5	-	5	3	-	3
56-60	14	-	15	5	-	5	6	-	7	7	-	7	3	-	4	2	-	2
61-65	6	-	6	3	-	3	8	1	9	2	-	4	1	-	2	-	-	-
66-70	2	-	2	2	-	2	1	1	3	3	-	3	3	-	3	-	-	-
71-75	1	1	2	-	-	-	-	-	-	1	-	1	3	-	4	-	-	-
76-80	-	-	-	1	-	1	-	1	1	-	1	1	5	-	5	-	-	-
81-85	-	1	1	-	-	-	-	3	4	-	1	1	1	-	1	-	-	-
86-90	-	1	1	1	-	1	-	2	2	-	1	1	1	-	1	-	-	-
91-95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
96-100	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-
101-105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
106-110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
111-115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
116-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
121-125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
126-130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SAMPLE SIZE	80	3	85	51	0	51	37	10	50	50	3	57	33	0	37	11	0	11
MEAN LENGTH	50.1	81.7	51.9	52.7	-	52.7	54.1	83.2	60.8	49.2	83	51.4	59.5	-	61.2	50.2	-	50.2
STANDAR DEV.	8.44	7.09	10.3	8.91	-	8.91	7.34	10.64	14.41	9.15	3.61	11.73	15.13	-	16.28	4.92	-	4.92
MEAN WEIGHT (G)	-	-	2.30	-	-	2.00	-	-	3.39	-	-	1.97	-	-	3.45	-	-	1.54
SAMPLE SIZE	-	-	85	-	-	51	-	-	50	-	-	57	-	-	37	-	-	11

CONTINUED

APPENDIX 6 CONTINUED.

LOCATION:	REACH 87			REACH 87			REACH 85			REACH 86			WARBONNET CR			WARBONNET CR		
DATE:	SEP 30			OCT 19			OCT 29			NOV 8			NOV 20			NOV 30		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)																		
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36-40	3	-	3	6	-	6	3	-	3	1	-	1	-	-	-	-	-	-
41-45	29	-	29	24	-	26	15	-	15	8	-	9	-	-	-	-	-	-
46-50	36	-	36	9	-	11	19	-	19	22	-	31	-	-	-	-	-	-
51-55	13	-	13	8	-	9	11	-	12	11	-	15	2	-	2	2	-	3
56-60	6	-	6	6	-	8	21	-	21	10	-	15	11	-	18	11	-	11
61-65	7	-	7	-	-	7	5	-	5	3	-	11	10	-	17	9	-	11
66-70	1	-	1	1	-	3	7	-	8	4	-	10	16	-	29	9	-	10
71-75	2	-	2	2	-	7	3	-	4	5	-	6	5	-	11	13	-	14
76-80	-	-	-	-	-	1	3	1	4	1	-	2	7	-	13	-	-	-
81-85	1	-	1	2	-	7	-	2	2	-	-	-	3	-	3	1	-	1
86-90	-	-	-	-	3	9	-	2	2	-	-	-	2	-	4	-	-	-
91-95	-	-	-	-	-	1	1	2	3	-	-	-	-	-	-	-	-	-
96-100	-	-	-	-	-	1	-	1	1	-	-	-	1	-	2	-	-	-
101-105	-	1	1	-	1	2	-	1	1	-	-	-	-	-	-	-	-	-
106-110	-	-	-	-	-	1	-	-	-	-	-	-	1	-	1	-	-	-
111-115	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
116-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
121-125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
126-130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SAMPLE SIZE	98	1	99	58	5	100	88	9	100	65	0	100	58	0	100	45	0	50
MEAN LENGTH	49.6	105	50.2	49.2	96	60.6	54.5	89.7	57.9	53.9	-	55.5	69	-	69	65.6	-	65.5
STANDAR DEV.	7.56	-	9.36	10.33	11.87	19.11	10.45	7.55	14.36	9.34	-	9.22	10.91	-	9.98	6.61	-	6.66
MEAN WEIGHT (G)	-	-	1.54	-	-	3.26	-	-	2.44	-	-	1.99	-	-	3.58	-	-	3.00
SAMPLE SIZE	-	-	99	-	-	101	-	-	75	-	-	102	-	-	100	-	-	50

CONTINUED

APPENDIX 6 CONTINUED..

LOCATION:	WARBONNET CR			REACH #6			REACH #8			TOTAL		
DATE:	JAN 7			JAN 8			JAN 8					
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)												
	-	-	-	-	-	-	-	-	-	1	0	1
36-40	-	-	-	-	-	-	-	-	-	36	0	37
41-45	-	-	-	1	-	1	-	-	-	129	0	132
46-50	-	-	-	6	-	9	1	-	2	147	0	164
51-55	-	-	-	2	-	3	1	-	2	100	0	109
56-60	5	-	5	3	-	6	3	-	4	113	0	134
61-65	5	-	5	1	-	2	1	-	2	61	1	91
66-70	8	-	8	1	-	2	5	-	5	63	1	89
71-75	9	-	9	-	-	1	6	-	6	50	1	67
76-80	12	-	12	-	-	-	1	-	2	30	3	42
81-85	3	-	3	-	-	-	-	-	-	11	7	24
86-90	5	-	5	1	-	1	1	-	1	11	9	28
91-95	1	-	1	-	-	-	-	-	-	2	2	5
96-100	1	1	2	-	-	-	-	-	-	2	4	8
101-105	-	-	-	-	-	-	-	1	1	0	4	6
106-110	-	-	-	-	-	-	-	-	-	1	0	2
111-115	-	-	-	-	-	-	-	-	-	0	1	1
116-120	-	-	-	-	-	-	-	-	-	0	0	0
121-125	-	-	-	-	-	-	-	-	-	0	0	0
126-130	-	-	-	-	-	-	-	-	-	0	0	0
SAMPLE SIZE	49	1	50	15	0	25	19	1	25	757	33	940
MEAN LENGTH	74	99	74.5	54.9	-	55.5	67.5	101	67.4	-	-	-
STANDAR DEV.	9.70	-	10.23	11.21	-	10.04	9.67	-	12.19	-	-	-
MEAN WEIGHT (G)	-	-	4.62	-	-	1.95	-	-	3.44	-	-	-
SAMPLE SIZE	-	-	25	-	-	25	-	-	25	-	-	-

APPENDIX 7. DAILY WATER TEMPERATURES IN THE BIRKENHEAD RIVER NEAR TWIN BRIDGES. 1982.

DATE	TEMPERATURE (C)			DATE	TEMPERATURE (C)			DATE	TEMPERATURE (C)		
	MIN.	MAX.	MEAN		MIN.	MAX.	MEAN		MIN.	MAX.	MEAN
AUG 18	9.50	14.00	11.75	OCT 7	7.00	9.00	8.00	NOV 26	1.00	1.50	1.25
19	10.00	14.50	12.25	8	6.50	9.00	7.75	27	1.50	2.00	1.75
20	11.00	14.50	12.75	9	7.00	9.00	8.00	28	2.00	3.00	2.50
21	11.00	15.00	13.00	10	6.50	9.50	8.00	29	3.00	3.50	3.25
22	11.00	14.50	12.75	11	8.00	10.00	9.00	30	3.00	3.50	3.25
23	11.50	15.50	13.50	12	7.00	9.50	8.25	DEC 1	2.50	3.50	3.00
24	11.50	16.00	13.75	13	9.50	9.50	9.50	2	3.00	3.50	3.25
25	11.50	15.50	13.50	14	9.00	10.00	9.50	3	1.50	2.00	1.75
26	12.00	15.50	13.75	15	9.50	10.00	9.75	4	2.00	3.00	2.50
27	12.00	13.00	12.50	16	7.00	10.00	8.50	5	1.50	2.00	1.75
28	11.50	13.50	12.50	17	9.00	10.00	9.50	6	1.00	1.50	1.25
29	11.00	13.00	12.00	18	4.50	6.50	5.50	7	0.50	1.00	0.75
30	11.50	13.50	12.50	19	5.00	6.50	5.75	8	0.50	1.50	1.00
31	11.50	14.00	12.75	20	4.50	6.50	5.50	9	0.50	1.00	0.75
SEP 1	11.00	14.50	12.75	21	6.00	6.50	6.25	10	0.00	1.00	0.50
2	11.00	15.00	13.00	22	6.50	6.50	6.50	11	0.50	1.50	1.00
3	11.50	14.00	12.75	23	5.50	6.50	6.00	12	1.00	2.00	1.50
4	11.50	13.00	12.25	24	6.00	6.50	6.25	13	2.00	2.50	2.25
5	11.50	13.50	12.50	25	6.50	8.00	7.25	14	2.00	3.00	2.50
6	11.00	13.00	12.00	26	6.50	6.50	6.50	15	2.00	2.50	2.25
7	11.50	12.00	11.75	27	6.00	6.50	6.25	16	1.50	2.00	1.75
8	11.00	12.00	11.50	28	6.00	6.50	6.25	17	1.00	3.00	2.00
9	10.00	11.00	10.50	29	5.00	6.00	5.50	18	3.00	3.00	3.00
10	9.50	11.50	10.50	30	4.50	5.50	5.00	19	2.50	3.00	2.75
11	9.50	10.50	10.00	31	5.50	6.00	5.75	20	2.00	2.00	2.00
12	9.00	12.00	10.50	NOV 1	5.00	6.00	5.50	21	2.00	2.00	2.00
13	9.50	12.00	10.75	2	4.00	5.00	4.50	22	1.50	2.00	1.75
14	9.00	12.00	10.50	3	4.00	5.50	4.75	23	2.00	2.50	2.25
15	9.50	10.50	10.00	4	5.50	5.50	5.50	24	1.50	3.00	2.25
16	9.50	13.50	11.50	5	5.00	5.50	5.25	25	3.00	3.00	3.00
17	10.00	13.50	11.75	6	4.50	5.00	4.75	26	2.00	2.00	2.00
18	10.00	13.50	11.75	7	4.50	5.00	4.75	27	0.00	1.00	0.50
19	10.50	13.50	12.00	8	4.00	5.00	4.50	28	0.00	-	-
20	10.00	13.00	11.50	9	3.00	4.00	3.50	29	-	-	-
21	11.00	14.00	12.50	10	2.00	3.50	2.75	30	-	-	-
22	10.50	13.50	12.00	11	2.00	3.50	2.75	31	-	-	-
23	10.00	13.50	11.75	12	2.50	4.00	3.25	JAN 1	-	-	-
24	10.50	14.00	12.25	13	2.00	3.50	2.75	2	-	-	-
25	11.00	14.50	12.75	14	1.50	3.00	2.25	3	-	-	-
26	9.50	12.00	10.75	15	1.50	3.00	2.25	4	-	3.00	-
27	10.00	11.00	10.50	16	3.00	3.50	3.25	5	2.00	3.00	2.50
28	9.50	11.00	10.25	17	3.50	4.00	3.75	6	2.00	3.00	2.50
29	8.50	11.00	9.75	18	3.00	3.50	3.25	7	3.00	3.00	3.00
30	8.00	11.00	9.50	19	2.00	3.00	2.50	8	2.00	3.00	2.50
OCT 1	7.50	10.50	9.00	20	2.00	2.50	2.25	9	2.00	2.00	2.00
2	9.50	10.50	10.00	21	0.00	1.00	0.50	10	2.00	3.50	2.75
3	8.00	9.50	8.75	22	-0.50	0.50	0.00				
4	6.50	10.50	8.50	23	-0.50	0.50	0.00				
5	7.00	9.00	8.00	24	0.00	0.50	0.25				
6	8.00	8.50	8.25	25	0.00	1.00	0.50				

APPENDIX 8a. SUMMARY OF LIVE AND DEAD ADULT COHO OBSERVATIONS DURING SPAWNING GROUND SURVEYS IN THE BIRKENHEAD RIVER SYSTEM, 1984 (UNLESS OTHERWISE NOTED, ALL DATA ARE FROM FOOT SURVEYS).

DATE	REACH	LIVE COUNT	DEAD RECOVERY								
			SECONDARY MARK ABSENT**			SECONDARY MARK PRESENT***				TOTAL NO. DEAD RECOVERY	NO. WITH ADIPOSE CLIPS
			ADULT MALE	ADULT FEMALE	JACK	DISK ABSENT		DISK PRESENT			
						MALE	FEMALE	MALE	FEMALE		
*OCT 30	ALL	2	0	0	0	0	0	0	0	0	0
NOV 20	4	-	2	1	0	0	0	0	0	3	0
*NOV 26	1	0	0	0	0	0	0	0	0	0	0
	2	420	-	-	-	-	-	-	-	2	-
	3	1200	0	0	0	0	0	0	0	0	0
	4	2800	0	0	0	0	0	0	0	0	0
	5	200	0	0	0	0	0	0	0	0	0
	6	100	0	0	0	0	0	0	0	0	0
	7	235	0	0	0	0	0	0	0	0	0
	8	190	0	0	0	0	0	0	0	0	0
	9	520	0	0	0	0	0	0	0	0	0
	10	480	0	0	0	0	0	0	0	0	0
NOV 28	2	40	1	0	0	0	0	0	0	1	0
	3	145	1	0	0	0	0	0	0	1	0
NOV 29	2	15	0	0	0	0	0	0	0	0	0
	4	1444	4	7	0	0	0	0	0	11	2
	5	10	0	0	0	0	0	0	0	0	0
	6	842	0	0	0	0	0	0	0	0	0
	8	573	0	0	0	0	0	0	1	1	0
NOV 30	4	700	0	0	0	0	0	0	0	0	0
	5	406	0	0	0	0	0	0	0	0	0
	6	961	0	1	0	0	0	0	0	1	0
	8	41	2	0	0	0	0	0	0	2	0
DEC 4	3	0	1	1	0	0	0	0	0	2	0
	4	521	1	1	0	0	0	0	1	3	0
	5	521	4	0	0	0	0	0	1	5	0
	6	966	9	1	0	0	0	0	0	10	1
	9	15	0	0	0	0	0	0	0	0	0
DEC 5	3	0	1	3	0	0	0	0	0	4	0
	4	696	0	0	0	0	0	0	0	0	0
	5	536	0	0	0	0	0	0	0	0	0
	6	965	5	1	0	0	0	0	1	7	0
DEC 6	3	15	1	2	0	0	0	0	0	3	1
	4	521	0	3	0	0	0	0	0	3	0
	5	445	1	1	0	0	0	0	0	2	0
	6	1063	0	1	0	0	0	0	0	1	0
	7	951	2	2	0	0	0	1	0	5	0
DEC 11	5	306	6	10	0	0	0	1	1	18	1
	6	765	7	12	0	0	0	0	2	21	0
DEC 12	3	8	0	2	1	0	0	0	0	3	0
	4	91	6	0	0	0	0	0	2	8	1
	5	330	4	0	0	0	0	0	2	6	1
	6	748	1	1	0	0	0	0	0	2	0
	7	327	12	5	0	0	0	3	1	21	2
	8	53	0	0	0	0	0	0	0	0	0
DEC 13	7	256	3	6	0	0	0	0	0	9	1
	8	503	16	14	0	0	0	3	2	35	3
	10	104	2	3	0	0	0	0	2	7	0

CONTINUED

* OBSERVATIONS FROM HELICOPTER OVERFLIGHT.
** COHO WHICH HAD NOT BEEN DISK TAGGED (NONE WERE FOUND WHICH HAD LOST A SECONDARY MARK).
*** ADULTS ONLY; JACKS DID NOT RECEIVE A DISK TAG OR SECONDARY MARK.

APPENDIX 8a CONTINUED.

DATE	REACH	LIVE COUNT	DEAD RECOVERY								
			SECONDARY MARK ABSENT**			SECONDARY MARK PRESENT***				TOTAL NO. DEAD RECOVERY	NO. WITH ADIPOSE CLIPS
			ADULT MALE	ADULT FEMALE	JACK	DISK ABSENT		DISK PRESENT			
						MALE	FEMALE	MALE	FEMALE		
DEC 14	4	75	3	1	0	0	0	0	0	4	0
	5	300	3	2	0	0	0	1	0	6	0
	6	700	4	5	0	0	0	1	0	10	0
	7	250	0	1	0	0	0	0	0	1	0
DEC 18	5	136	9	8	0	0	0	2	1	20	0
	6	215	4	5	0	0	0	1	1	11	1
DEC 19	8	500	30	43	0	0	1	5	4	83	7
	9	41	0	0	0	0	0	0	0	0	0
DEC 20	4	100	2	5	0	0	0	0	0	7	0
	5	95	5	3	0	0	0	0	1	9	0
	6	207	5	13	0	0	0	3	1	22	2
	7	230	7	9	0	0	0	0	1	17	0
DEC 21	4	17	1	0	0	0	0	0	0	1	0
	8	500	21	22	0	1	0	4	3	51	5
	9	50	0	0	0	0	0	0	0	0	0
DEC 28	5	140	28	18	0	0	0	5	2	53	2
	6	120	21	34	0	1	0	6	3	65	3
DEC 29	6	300	22	29	0	0	0	4	1	56	2
	8	210	35	28	0	0	0	4	2	69	7
DEC 30	8	200	24	33	0	0	0	4	2	63	9
JAN 3	5	50	15	12	0	0	0	1	1	29	2
JAN 4	6	500	33	29	0	1	0	2	1	66	7
	7	218	17	23	0	0	0	6	2	48	7
JAN 5	8	175	52	59	0	0	0	10	6	127	12
JAN 6	5	10	6	9	0	0	0	2	0	17	0
REACH SUMMARIES	2	-	1	0	0	0	0	0	0	1	0
	3	-	4	8	1	0	0	0	0	13	1
	4	-	19	18	0	0	0	0	3	40	3
	5	-	81	63	0	0	0	12	9	165	6
	6	-	111	132	0	2	0	17	10	272	16
	7	-	41	46	0	0	0	10	4	101	10
	8	-	180	199	0	1	1	30	20	431	43
	9	-	0	0	0	0	0	0	0	0	0
	10	-	2	3	0	0	0	0	2	7	0
TOTAL	-	-	439	469	1	3	1	69	48	1030	79

* OBSERVATIONS FROM HELICOPTER OVERFLIGHT.
** COHO WHICH HAD NOT BEEN DISK TAGGED (NONE WERE FOUND WHICH HAD LOST A SECONDARY MARK).
*** ADULTS ONLY; JACKS DID NOT RECEIVE A DISK TAG OR SECONDARY MARK.

APPENDIX Bb. RECOVERIES OF ADULT COHO SALMON WITH ADIPOSE CLIPS RECOVERED DURING FOOT SURVEYS IN THE BIRKENHEAD RIVER SYSTEM, 1984.

DATE	REACH	DEAD RECOVERY							
		SECONDARY MARK ABSENT*			SECONDARY MARK PRESENT**				TOTAL ADIPOSE CLIPS RECOVERED
		ADULT MALE	ADULT FEMALE	JACK	DISK ABSENT		DISK PRESENT		
					MALE	FEMALE	MALE	FEMALE	
NOV 20	4	0	0	0	0	0	0	0	0
NOV 28	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
NOV 29	2	0	0	0	0	0	0	0	0
	4	1	1	0	0	0	0	0	2
	5	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0
NOV 30	4	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0
DEC 4	3	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0
	6	1	0	0	0	0	0	0	1
	9	0	0	0	0	0	0	0	0
DEC 5	3	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0
DEC 6	3	1	0	0	0	0	0	0	1
	4	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0
DEC 11	5	0	0	0	0	0	1	0	1
	6	0	0	0	0	0	0	0	0
DEC 12	3	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	1	1
	5	1	0	0	0	0	0	0	1
	6	0	0	0	0	0	0	0	0
	7	2	0	0	0	0	0	0	2
	8	0	0	0	0	0	0	0	0
DEC 13	7	0	1	0	0	0	0	0	1
	8	1	1	0	0	0	0	1	3
	10	0	0	0	0	0	0	0	0
DEC 14	4	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0

* COHO WHICH HAD NOT BEEN DISK TAGGED (NONE WERE FOUND WHICH HAD LOST A SECONDARY MARK). CONTINUED
** ADULTS ONLY; JACKS DID NOT RECEIVE A DISK TAG OR SECONDARY MARK.

APPENDIX 8b CONTINUED.

DATE	REACH	DEAD RECOVERY							
		SECONDARY MARK ABSENT*			SECONDARY MARK PRESENT**				TOTAL DEAD RECOVERY
		ADULT MALE	ADULT FEMALE	JACK	DISK ABSENT		DISK PRESENT		
					MALE	FEMALE	MALE	FEMALE	
DEC 18	5	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	1	0	1
DEC 19	8	1	6	0	0	0	0	0	7
	9	0	0	0	0	0	0	0	0
DEC 20	4	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0
	6	0	2	0	0	0	0	0	2
	7	0	0	0	0	0	0	0	0
DEC 21	4	0	0	0	0	0	0	0	0
	8	2	2	0	1	0	0	0	5
	9	0	0	0	0	0	0	0	0
DEC 28	5	1	0	0	0	0	1	0	2
	6	1	1	0	0	0	1	0	3
DEC 29	6	0	2	0	0	0	0	0	2
	8	3	3	0	0	0	1	0	7
DEC 30	8	3	4	0	0	0	1	1	9
JAN 3	5	2	0	0	0	0	0	0	2
JAN 4	6	2	3	0	1	0	0	1	7
	7	2	4	0	0	0	1	0	7
JAN 5	8	7	5	0	0	0	0	0	12
JAN 6	5	0	0	0	0	0	0	0	0
REACH SUMMARIES	2	0	0	0	0	0	0	0	0
	3	1	0	0	0	0	0	0	1
	4	1	1	0	0	0	0	1	3
	5	4	0	0	0	0	2	0	6
	6	4	8	0	1	0	2	1	16
	7	4	5	0	0	0	1	0	10
	8	17	21	0	1	0	2	2	43
	9	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0
TOTAL	-	31	35	0	2	0	7	4	79

* COHO WHICH HAD NOT BEEN DISK TAGGED (NONE WERE FOUND WHICH HAD LOST A SECONDARY MARK).
** ADULTS ONLY: JACKS DID NOT RECEIVE A DISK TAG OR SECONDARY MARK.

APPENDIX 9. SUMMARY OF DISK TAG APPLICATION RESULTS IN THE BIRKENHEAD RIVER. 1984.

DATE	REACH	ADIPOSE PRESENT			ADIPOSE ABSENT			TOTAL		
		MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL
NOV 6	4	5	2	7	1	0	1	6	2	8
NOV 7	4	26	14	40	1	1	2	27	15	42
NOV 8	4	84	26	110	2	0	2	86	26	112
NOV 9	4	88	42	130	4	2	6	92	44	136
NOV 10	4	87	48	135	3	3	6	90	51	141
NOV 11	4	90	71	161	5	7	12	95	78	173
NOV 12	4	69	53	122	4	4	8	73	57	130
NOV 13	4	59	50	109	6	3	9	65	53	118
NOV 14	4	55	34	89	1	2	3	56	36	92
NOV 18	4	20	14	34	1	0	1	21	14	35
NOV 19	4	62	54	116	5	2	7	67	56	123
NOV 20	4	59	49	108	3	1	4	62	50	112
NOV 21	4	54	38	92	6	1	7	60	39	99
NOV 22	4	31	11	42	1	0	1	32	11	43
TOTAL	-	789	506	1295	43	26	69	832	532	1364

NOTE - ONLY ADULT COHO WERE DISK TAGGED: 11 JACK COHO (PRECOCIOUS MALES) WERE RELEASED UNTAGGED.
- 15 DISK TAGS WERE ELIMINATED DUE TO POOR CONDITION AT RELEASE (BLEEDING ABDOMEN OR CONDITION 2 OR 3): ALL HAD ADIPOSE FINS.
- DATA ARE NOT ADJUSTED FOR ERRORS IN SEX IDENTIFICATION (SEE APPENDIX 10).

APPENDIX 10. SUMMARY OF DISK TAG RECOVERIES IN THE BIRKENHEAD RIVER SYSTEM, 1984.

DISK TAG APPLICATION					DISK TAG RECOVERY				TIME OUT (DAYS)
REACH	DATE	NOSE-FORK LENGTH	SEX	ADIPOSE CLIP	REACH	DATE	PO-HYP LENGTH (CM)	SEX	
4	NOV 6	72.00cm	MALE	YES	6	JAN 4	59.50	FEMALE*	59
4	NOV 7	62.00	MALE	NO	6	DEC 20	47.50	MALE	43
	NOV 7	72.00	MALE	YES	6	DEC 28	57.50	MALE	51
4	NOV 8	65.00	FEMALE	NO	7	JAN 4	50.50	FEMALE	57
	NOV 8	64.00	MALE	NO	8	DEC 19	51.50	MALE	41
	NOV 8	58.00	MALE	NO	8	JAN 5	46.00	MALE	58
	NOV 8	62.00	FEMALE	NO	8	DEC 19	49.50	FEMALE	41
	NOV 8	59.00	MALE	NO	8	DEC 19	45.00	MALE	41
4	NOV 9	55.00	FEMALE	NO	8	DEC 13	47.00	FEMALE	34
	NOV 9	59.00	FEMALE	YES	8	DEC 13	49.00	FEMALE	34
	NOV 9	69.00	MALE	NO	6	DEC 14	52.00	MALE	35
	NOV 9	62.00	MALE	NO	8	DEC 30	53.00	MALE	51
	NOV 9	67.00	MALE	NO	8	DEC 19	52.00	MALE	40
4	NOV 10	70.00	MALE	NO	8	DEC 30	59.00	MALE	50
	NOV 10	69.00	FEMALE	NO	10	DEC 13	54.50	FEMALE	33
	NOV 10	67.00	MALE	NO	7	DEC 6	52.50	MALE	26
	NOV 10	62.00	MALE	NO	8	DEC 21	47.50	MALE	41
	NOV 10	70.00	FEMALE	NO	5	DEC 4	58.00	FEMALE	24
	NOV 10	48.00	MALE	NO	6	DEC 28	38.00	MALE	48
	NOV 10	71.00	FEMALE	NO	10	DEC 13	57.00	FEMALE	33
	NOV 10	66.00	FEMALE	NO	8	JAN 5	54.00	FEMALE	56
	NOV 10	70.00	MALE	NO	7	JAN 4	54.00	MALE	55
	NOV 10	70.00	FEMALE	NO	8	JAN 5	55.00	FEMALE	56
4	NOV 11	64.00	MALE	NO	6	DEC 29	50.50	MALE	48
	NOV 11	60.00	MALE	NO	8	DEC 29	47.50	MALE	48
	NOV 11	74.00	MALE	NO	8	DEC 21	59.00	MALE	40
	NOV 11	75.00	MALE	NO	5	DEC 18	56.00	MALE	37
	NOV 11	62.00	MALE	NO	8	DEC 21	50.00	MALE	40
	NOV 11	75.00	FEMALE	NO	5	DEC 12	61.00	FEMALE	31
	NOV 11	66.00	MALE	NO	8	JAN 5	52.00	MALE	55
	NOV 11	66.00	FEMALE	NO	6	DEC 5	53.00	FEMALE	24
	NOV 11	70.00	MALE	NO	6	DEC 29	54.00	MALE	48
	NOV 11	60.00	FEMALE	NO	8	DEC 19	49.00	FEMALE	38
	NOV 11	54.00	FEMALE	YES	5	DEC 28	44.00	MALE*	47
	NOV 11	61.00	MALE	NO	5	DEC 28	48.00	MALE	47
	NOV 11	67.00	FEMALE	NO	8	JAN 5	53.00	FEMALE	55
	NOV 11	69.00	FEMALE	NO	5	DEC 18	55.50	FEMALE	37
	NOV 11	55.00	MALE	NO	8	DEC 29	42.50	MALE	48
	NOV 11	59.00	FEMALE	NO	8	DEC 13	48.00	MALE*	32
	NOV 11	58.00	FEMALE	NO	8	DEC 19	48.00	FEMALE	38
	NOV 11	54.00	MALE	YES	5	DEC 11	41.50	MALE	30
	NOV 11	61.00	MALE	NO	5	DEC 18	43.00	MALE	37
	NOV 11	51.00	MALE	YES	6	DEC 18	39.50	MALE	37
	NOV 11	71.00	FEMALE	NO	6	DEC 28	57.50	FEMALE	47
	NOV 11	64.00	FEMALE	NO	8	DEC 19	53.00	FEMALE	38
4	NOV 12	69.00	MALE	NO	7	DEC 12	54.50	MALE	30
	NOV 12	50.00	MALE	NO	6	DEC 11	42.00	FEMALE*	29
	NOV 12	50.00	MALE	NO	8	JAN 5	40.50	MALE	54
	NOV 12	65.00	FEMALE	NO	6	DEC 28	54.50	FEMALE	46
	NOV 12	66.00	MALE	YES	8	DEC 29	51.50	MALE	47
	NOV 12	71.00	FEMALE	NO	5	DEC 28	59.50	FEMALE	46
	NOV 12	65.00	FEMALE	YES	8	DEC 30	57.50	FEMALE	48
	NOV 12	55.00	MALE	NO	8	JAN 5	48.00	MALE	54
	NOV 12	68.00	FEMALE	NO	8	DEC 13	54.00	MALE*	31

* SEXED INCORRECTLY DURING TAG APPLICATION PROCEDURES.

CONTINUED

APPENDIX 10 CONTINUED.

DISK TAG APPLICATION					DISK TAG RECOVERY				TIME OUT (DAYS)
REACH	DATE	NOSE-FORK LENGTH	SEX	ADIPOSE CLIP	REACH	DATE	PO-HYP LENGTH (CM)	SEX	
4	NOV 12	56.00	FEMALE	NO	8	DEC 29	47.50	FEMALE	47
	NOV 12	68.00	FEMALE	NO	8	DEC 21	56.50	FEMALE	39
	NOV 12	68.00	FEMALE	NO	7	DEC 12	54.50	FEMALE	30
	NOV 12	74.00	MALE	NO	5	DEC 28	58.00	MALE	46
	NOV 12	61.00	FEMALE	NO	8	NOV 29	51.00	FEMALE	17
	NOV 12	65.00	MALE	NO	8	JAN 5	51.00	MALE	54
	NOV 12	49.00	MALE	NO	8	JAN 5	38.00	MALE	54
	NOV 12	69.00	FEMALE	NO	7	JAN 4	55.50	FEMALE	53
	NOV 12	68.00	FEMALE	NO	4	DEC 4	55.00	FEMALE	22
4	NOV 13	63.00	FEMALE	NO	8	DEC 21	50.50	FEMALE	38
	NOV 13	59.00	MALE	NO	6	DEC 29	53.50	MALE	46
	NOV 13	51.00	MALE	NO	8	DEC 21	*40	MALE	38
	NOV 13	65.00	MALE	NO	6	DEC 29	53.00	MALE	46
	NOV 13	68.00	MALE	NO	8	DEC 13	54.50	MALE	30
	NOV 13	75.00	MALE	NO	8	DEC 29	57.50	MALE	46
	NOV 13	64.00	FEMALE	NO	5	DEC 28	55.00	FEMALE	45
	NOV 13	80.00	MALE	NO	7	JAN 4	61.50	MALE	52
	NOV 13	76.00	MALE	NO	8	DEC 29	57.50	FEMALE‡	46
4	NOV 14	77.00	FEMALE	NO	4	DEC 12	64.50	FEMALE	28
	NOV 14	63.00	MALE	NO	8	JAN 5	50.00	MALE	52
	NOV 14	69.00	MALE	NO	7	JAN 4	53.00	MALE	51
	NOV 14	71.00	MALE	NO	6	DEC 20	58.00	MALE	36
	NOV 14	64.00	MALE	NO	8	JAN 5	51.00	MALE	52
	NOV 14	71.00	MALE	NO	7	DEC 12	55.00	MALE	28
	NOV 14	68.00	FEMALE	NO	5	DEC 20	54.50	FEMALE	36
	NOV 14	63.00	MALE	NO	7	DEC 12	52.00	MALE	28
4	NOV 18	62.00	FEMALE	NO	8	JAN 5	51.00	FEMALE	48
	NOV 18	66.00	MALE	NO	6	DEC 28	55.00	MALE	40
	NOV 18	71.00	FEMALE	NO	5	DEC 14	58.00	MALE‡	26
	NOV 18	67.00	MALE	NO	5	JAN 5	51.50	MALE	48
	NOV 18	77.00	FEMALE	NO	6	DEC 11	61.00	FEMALE	23
	NOV 18	80.00	MALE	NO	6	JAN 4	62.00	MALE	47
	NOV 18	57.00	MALE	NO	8	JAN 5	44.00	MALE	48
4	NOV 19	61.00	FEMALE	NO	5	DEC 11	51.00	FEMALE	22
	NOV 19	60.00	FEMALE	NO	8	DEC 21	48.00	FEMALE	32
	NOV 19	54.00	MALE	YES	7	JAN 4	42.50	MALE	46
	NOV 19	62.00	MALE	YES	8	DEC 30	53.00	MALE	41
	NOV 19	51.00	MALE	NO	6	DEC 28	43.00	MALE	39
	NOV 19	59.00	MALE	NO	8	DEC 19	45.50	MALE	30
	NOV 19	77.00	MALE	NO	7	JAN 4	57.50	MALE	46
	NOV 19	82.00	MALE	NO	5	JAN 3	63.50	MALE	45
	NOV 19	74.00	FEMALE	NO	5	DEC 12	59.50	FEMALE	23
	NOV 19	70.00	MALE	NO	5	JAN 6	52.50	MALE	48
	NOV 19	43.00	MALE	NO	6	DEC 20	36.00	MALE	31
	NOV 19	66.00	FEMALE	NO	6	DEC 28	53.00	FEMALE	39
4	NOV 20	44.00	MALE	NO	6	DEC 28	38.00	MALE	38
	NOV 20	64.00	MALE	NO	5	DEC 28	50.00	MALE	38
	NOV 20	64.00	FEMALE	YES	4	DEC 12	51.00	FEMALE	22
	NOV 20	63.00	FEMALE	NO	6	DEC 20	51.00	FEMALE	30
	NOV 20	61.00	FEMALE	NO	8	JAN 5	49.50	FEMALE	46
	NOV 20	83.00	MALE	NO	5	DEC 28	62.50	MALE	38
	NOV 20	70.00	FEMALE	NO	5	JAN 3	57.50	FEMALE	44

‡ SEXED INCORRECTLY DURING TAG APPLICATION PROCEDURES.

CONTINUED

APPENDIX 10 CONTINUED.

DISK TAG APPLICATION					DISK TAG RECOVERY				TIME OUT
REACH	DATE	NOSE-FORK LENGTH	SEX	ADIPOSE CLIP	REACH	DATE	PO-HYP LENGTH (CM)	SEX	(DAYS)
4	NOV 21	69.00	FEMALE	NO	6	DEC 18	55.00	FEMALE	27
	NOV 21	64.00	MALE	NO	6	DEC 28	51.00	MALE	37
	NOV 21	67.00	FEMALE	NO	7	DEC 20	56.00	FEMALE	29
	NOV 21	55.00	MALE	NO	6	JAN 4	46.00	MALE	44
4	NOV 22	74.00	MALE	NO	7	JAN 4	56.00	MALE	43
	NOV 22	69.00	FEMALE	NO	6	DEC 29	54.00	FEMALE	37
	NOV 22	53.00	MALE	NO	8	DEC 30	47.50	MALE	38
	NOV 22	59.00	FEMALE	NO	8	JAN 5	48.00	FEMALE	44
	NOV 22	72.00	MALE	NO	8	DEC 19	56.00	MALE	27
	NOV 22	63.00	FEMALE	NO	8	DEC 30	55.00	FEMALE	36
	NOV 22	58.00	MALE	NO	8	JAN 5	45.50	MALE	44

SUMMARY

	MALE	FEMALE
ADIPOSE ABSENT -	7	4
ADIPOSE PRESENT -	62	44
TOTAL	69	48

MEAN TIME OUT - 40.51 DAYS
MIN. TIME OUT - 17.00 DAYS
MAX. TIME OUT - 59.00 DAYS

FEMALES MISIDENTIFIED AS MALES DURING TAG APPLICATION - NUMBER 3
- PERCENT 6.3

MALES MISIDENTIFIED AS FEMALES DURING TAG APPLICATION - NUMBER 4
- PERCENT 5.8

* SEXED INCORRECTLY DURING TAG APPLICATION PROCEDURES.

APPENDIX 11. SUMMARY OF SAMPLE DATA FOR ADIPOSE-CLIPPED COHO RECOVERED DURING SPAWNING GROUND SURVEYS IN BIRKENHEAD RIVER SYSTEM. 1984.

DATE	REACH	PO-HYP LENGTH (CM)	SEX	CLIP CONDITION	CARCASS CONDITION	EYES	CWT CODE	AGE
NOV 29	4	51.50	MALE	2	2	PRESENT	02 22 09	3/2
NOV 29	4	48.00	FEMALE	1	1	PRESENT	02 22 09	3/2
DEC 4	6	49.00	MALE	1	2	PRESENT	02 22 09	3/2
DEC 6	6	34.50	MALE	2	4	PRESENT	NO TAG	3/2
DEC 11	5	41.50	MALE	1	2	PRESENT	02 22 09	3/2
DEC 12	4	51.00	FEMALE	1	3	PRESENT	02 23 26	3/2
DEC 12	5	47.00	MALE	1	3	PRESENT	02 22 09	3/2
DEC 12	7	49.00	MALE	1	2	PRESENT	02 22 09	3/2
DEC 12	7	36.50	MALE	2	2	PRESENT	NO TAG	3/2
DEC 13	8	49.00	FEMALE	1	2	PRESENT	02 22 09	3/2
DEC 13	8	48.00	MALE	1	3	ABSENT	02 22 09	3/2
DEC 13	8	48.00	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 13	7	48.50	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 18	6	39.50	MALE	1	2	PRESENT	02 22 09	REGEN
DEC 19	8	56.00	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 19	8	52.00	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 19	8	52.00	MALE	1	3	ABSENT	TAG LOST	3/2
DEC 19	8	51.00	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 19	8	58.00	FEMALE	1	3	ABSENT	02 22 09	3/2
DEC 19	8	48.00	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 19	8	51.00	FEMALE	1	3	PRESENT	02 23 26	3/2
DEC 20	6	46.00	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 20	6	58.50	FEMALE	1	3	ABSENT	02 22 09	REGEN
DEC 21	8	45.00	MALE	1	3	PRESENT	02 22 09	3/2
DEC 21	8	48.00	MALE	1	3	PRESENT	02 22 09	4/3
DEC 21	8	50.00	FEMALE	1	3	ABSENT	02 22 09	3/2
DEC 21	8	56.00	MALE	1	3	PRESENT	02 22 09	3/2
DEC 21	8	57.00	FEMALE	1	3	PRESENT	NO TAG	3/2
DEC 28	5	52.50	MALE	1	3	PRESENT	02 22 09	3/2
DEC 28	5	44.00	MALE	1	3	PRESENT	02 22 09	3/2
DEC 28	6	55.50	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 28	6	51.00	MALE	1	3	PRESENT	02 22 09	3/2
DEC 28	6	57.50	MALE	1	3	PRESENT	02 22 09	3/2
DEC 29	6	48.50	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 29	6	53.00	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 29	8	51.50	FEMALE	1	3	ABSENT	NO TAG	4/3
DEC 29	8	46.00	FEMALE	1	3	ABSENT	02 22 09	REGEN
DEC 29	8	49.00	MALE	1	3	ABSENT	02 22 09	REGEN
DEC 29	8	51.50	MALE	1	3	ABSENT	TAG LOST	3/2
DEC 29	8	45.00	MALE	1	3	PRESENT	02 22 09	3/2
DEC 29	8	42.00	MALE	1	3	PRESENT	02 22 09	3/2
DEC 29	8	59.00	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 30	8	52.00	MALE	1	3	PRESENT	02 22 09	3/2
DEC 30	8	57.50	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 30	8	57.00	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 30	8	57.00	FEMALE	1	3	PRESENT	NO TAG	3/2
DEC 30	8	57.50	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 30	8	53.00	MALE	1	3	ABSENT	02 22 09	REGEN
DEC 30	8	53.00	MALE	1	3	PRESENT	02 22 09	REGEN
DEC 30	8	58.00	FEMALE	1	3	PRESENT	02 22 09	3/2
DEC 30	8	53.00	MALE	1	3	PRESENT	02 22 09	REGEN
JAN 3	5	48.00	MALE	1	3	PRESENT	02 22 09	3/2
JAN 3	5	48.50	MALE	1	3	PRESENT	02 22 09	3/2
JAN 4	6	59.50	FEMALE	1	4	PRESENT	02 23 26	3/2
JAN 4	6	38.50	MALE	1	3	PRESENT	02 23 26	4/3
JAN 4	6	44.50	MALE	1	3	PRESENT	02 22 09	3/2
JAN 4	6	45.00	FEMALE	1	3	PRESENT	02 22 09	3/2
JAN 4	6	49.00	MALE	1	3	PRESENT	02 22 09	3/2
JAN 4	6	53.00	FEMALE	1	3	ABSENT	02 22 09	3/2
JAN 4	6	55.50	FEMALE	1	3	PRESENT	02 22 09	3/2

CONTINUED

APPENDIX 11 CONTINUED.

DATE	REACH	PO-HYP LENGTH (CM)	SEX	CLIP COND-ITION	CARCASS COND-ITION	EYES	CWT CODE	AGE
JAN 4	7	56.00	FEMALE	1	3	PRESENT	02 23 26	3/2
JAN 4	7	57.50	MALE	1	3	PRESENT	02 22 09	3/2
JAN 4	7	54.00	FEMALE	1	3	PRESENT	02 22 09	3/2
JAN 4	7	57.50	FEMALE	1	3	PRESENT	02 22 09	3/2
JAN 4	7	42.50	MALE	1	3	PRESENT	02 23 26	3/2
JAN 4	7	56.50	FEMALE	1	3	PRESENT	02 22 09	3/2
JAN 4	7	53.00	MALE	1	3	PRESENT	NO TAG	REGEN
JAN 5	8	48.00	FEMALE	1	3	ABSENT	02 22 09	3/2
JAN 5	8	50.00	MALE	1	3	PRESENT	02 22 09	REGEN
JAN 5	6	46.00	MALE	1	3	ABSENT	02 22 09	3/2
JAN 5	8	51.00	FEMALE	1	3	PRESENT	02 22 09	3/2
JAN 5	8	50.00	MALE	1	3	PRESENT	02 22 09	3/2
JAN 5	8	57.00	FEMALE	1	3	PRESENT	02 22 09	3/2
JAN 5	8	39.50	MALE	1	3	PRESENT	02 22 09	3/2
JAN 5	8	38.00	MALE	1	3	PRESENT	NO TAG	3/2
JAN 5	8	52.00	FEMALE	1	3	PRESENT	02 22 09	3/2
JAN 5	6	41.00	MALE	1	4	ABSENT	02 22 09	3/2
JAN 5	8	53.50	FEMALE	1	3	PRESENT	02 22 09	3/2
JAN 5	8	46.50	MALE	1	3	ABSENT	02 22 09	3/2

SUMMARY

A. RECOVERY BY TAG CODE:

CODE 02 22 09 - 84
CODE 02 23 26 - 6
NO TAG - 7 (8.9%)
TAG LOST - 2

B. AGE/LENGTH/SEX SUMMARY:

AGE	SEX	n	REL %	MEAN LENGTH	s
4/3	MALE	2	2.9	43.30	6.72
	FEMALE	1	1.4	51.50	-
3/2	MALE	31	44.3	47.00	5.78
	FEMALE	36	51.4	53.20	4.11
TOTAL	MALE	40	50.6	47.30	5.78
	FEMALE	39	49.4	53.20	4.14